Treatment Planning Approaches for Reducing Hot Spots - Tips and Tricks

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About Me

• Valerie Elizabeth Ostrowski R.T.(T)
• From Nappanee, Indiana
• Introduced To The Field Through Brother’s Hodgkin Lymphoma Treatments
• Indiana University-Purdue University Indianapolis B.S. Radiation Therapy, 2018
• Indiana University School Of Medicine Medical Dosimetry Graduate Certificate Program, 2019
Treatment Planning Approaches for Reducing Hot Spots

WHAT DO I MEAN BY HOT SPOT?

OUTLINE

- Patient Care
- Comparing Acceptable Plans
- Standard Field in Field
- Reverse Field in Field
- Editing Electronic Compensator Fluence
- Editing MLC’s on 3D Conformal Arc’s
- Collimator Considerations
- IMRT Approaches
- Questions & Conclusion
AAMD AND PATIENT CARE

AAMD Vision:
• Empowering medical dosimetrists and treatment planners to improve the quality of life of our patients and their families.

AAMD Mission Statement
• Defining the scope of practice for medical dosimetry and treatment planning to ensure the delivery of high quality patient care and to foster patient safety initiatives.

AAMD Code of Ethics:
• Patient: Although never directly responsible for prescribing medical procedures, the health and welfare (even life) of many patients may directly depend upon the quality with which Medical Dosimetrists carry out their work.

COMPARISON OF PLANS

4-FIELD BOX

4-FIELD BOX WITH SUBFIELDS
Treatment Planning Techniques

Field in Field Techniques

IMPROVEMENTS I HAVE MADE TO MY APPROACH
**Standard FiF**

- Ensure Adequate Target Coverage
- Drop Dose Levels ~3%
- Evaluate Axial Slices To See Which Field Is Optimal For Dose Reduction
- Cover 3D Isodose With MLC
- Add Weight To Subfield From Initial Field Until Dose Level Is Gone
- Keep Adding Weight Until Hotspot Pops Out From Under MLC
STANDARD FiF

- Ideal For Prone Breast
- Isocenter Outside Of Body
**Reverse FiF**

- Start with desired dose level (~105-107%) in 3D
- Block out with MLC
- Typically limit to ~10 MU
- Do other side continuing to block out ~105-107%
- 3D dose will be less volume every time
- Prevents field merging issues
- Know where the 105-107% will be once finished

**Advantages of FiF**
Editing Electronic Compensator Fluence

A DIFFERENT APPROACH TO FIELD IN FIELD

- Appropriately weight fields as you would normally
- Apply a electronic compensator to each field
- Erase fluence
- Paint in 100% transmission
- Dose paint out hotspots
Editing E’Comp Fluence

Editing E-Comp Fluence
E-Comp Dose Distribution

E'Comp Fluence for Irregular Shaped Fields
E'Comp Fluence for Irregular Shaped Fields
Dose Profile Tools

- PROFILE LINE
- PROFILE POINT

Dose Profile Tool
Dose Profile Tool

Dose Profile Tool
Dose Point Tool

<table>
<thead>
<tr>
<th>Field</th>
<th>Normalized Dose</th>
<th>Unnormalized Dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>ROI</td>
<td>0.8 %</td>
<td>0.8 %</td>
</tr>
<tr>
<td>LPO</td>
<td>80.2 %</td>
<td>80.6 %</td>
</tr>
</tbody>
</table>

Editing MLC for 3D Dynamic Arc
Editing MLC for 3D Dynamic Arc

• Good At Creating A Very Conformal Dose Distribution
• Ideal For Rounder Targets
• Insert Dynamic Arc
• Change Angle Step/Number Of Control Points
• Rotate Until Achievable Angle To Reduce Dose To Desired Level
• Do Multiple Angles For Each Area Of Reduction
• Verify MLC Leaf Positions

Editing MLC for 3D Dynamic Arc

• MLC Properties
• Increase Angle Step/Number Of Control Points
• Reduces Number Of Angles To Edit MLCs On
• Edit Multiple Angle's In A Row – Gradually Cover Hotspot
Editing MLC for 3D Dynamic Arc

- Find Optimal Angle To Reduce Dose
- Cover With MLC
- Repeat This For A Few Sequential Angles To Gradually Pull MLC’s Out (Achievable Leaf Position)

Editing MLC for 3D Dynamic Arc
Editing MLC for 3D Dynamic Arc

- Verify MLC Leaf Position
- MLC Travel Time/Distance
- Confirms The Machine Achieve This

5 FIELD PELVIS

1 3D DYNAMIC ARC PELVIS
Collimator Considerations

Collimator Rotation Eliminating Leaf Leakage

- Dynamic Treatment Delivery, VMAT/IMRT Requires MLC Movement
- MLC Leakage Could Be A Significant Problem
- To Minimize Leakage, Collimator Angles Are Utilized
- An Optimal Collimator Angle Was Investigated And Found To Be A 15-20 Degree Collimator Rotation (e.g. 15 & 345)
Optimal Collimator Angle for Anatomy

Optimal Primary Collimators
Plan Evaluation


Hotspots – When, Where, Why?
Hotspots – When, Where, Why?

• Crop Target ~3mm From Skin
• Not Ideal If Disease Extends To Skin
• At Physician Discretion
Hotspots – When, Where, Why?

- Bone Hotspots
- Segmentation Wizard – Bone
- Bone Optimization Structure
- Reduce or Eliminate Dose In Bone

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Hotspots – When, Where, Why?

- Drawing Tools – Segmentation Wizard
- Select Organ To Be Segmented – Bone
- Set Volume Of Interest (VOI)
- Apply
- Optimize On Structure
Hotspots – When, Where, Why?

![Image of medical imaging with annotations]

Hotspots – When, Where, Why?

![Image of medical imaging with annotations]
Hotspots – When, Where, Why?

• SBRT Spine
• Typical To Have Hotspot At Junction – Why?
• Pushing The Cord Hard Through Optimization To Meet Constraint
• Able To Make Dose Falloff Faster At The Cost Of Hotspot
Hotspots – When, Where, Why?

IMRT Approaches

OPTIMIZATION STRUCTURES
Optimization Structures

• Target Overlapping With OAR
• Goal: Acquire Tumoricidal Dose While Achieving OAR Constraint
• Create Inner And Outer Optimization Structures
Optimization Structures

- Optimization Ring/Doughnut Structures
- Created To Maximize Falloff Of Dose
- Force Hotspot To Specific Location (GTV/ITV)
Optimization Structures

• Posterior Suppression
• Goal: Carve ~50% Off Rectum
Optimization Structures

- CARVES 50% OFF THE RECTUM

Case Studies

- IMRT CRANIOSPINAL – DOSE FEATHERING
- H&N WITH PACEMAKER
Case Study: IMRT Craniospinal

- Avoid Shoulders
- Avoid Jaw
- 2 cm or more of overlap (vendor recommended)
- Optimize as one plan; optimize on single PTV
- Break it into 3 separate plans
Case Study: 3D Craniospinal

- 3D Plan Match Lines
- Hot At Divergence Overlap
- Cold At Match
- IMRT Produces Homogenous Feathering Of Dose

Craniospinal Case Study
H&N With Pacemaker Near Field

- Typically Use VMAT For H&N
- Hard To Achieve Pacemaker Dose With VMAT
- Split Targets Into Superior/Inferior Optimization Structures
- VMAT Utilized On Superior Targets
- Static IMRT Utilized On Inferior Targets
THANK YOU

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QUESTIONS?