Debate Motion

"Arc Based Techniques Will Make Conventional IMRT Obsolete"

AGAINST the Motion:
Peter Balter, Ph.D.

Potential Conflicts of Interest:
Dr. Balter has research support/collaborations with
Varian Associates
Philips Medical Systems
Sun Nuclear Corporation
All of whom have products show in this presentation

Theoretical benefits of VMAT:

- Faster treatment delivery

Real Costs of VMAT

- Linac upgrade
- TPS Upgrade
- R&V Upgrade
- IMRT QA system upgrade
- Increased linac downtime
- Longer planning time
- Greater physics QA time
Linac Upgrade

- Costs to upgrade an existing linac
  - $150,000-$250,000
- What do you get for your quarter million?
  - Flag is changed from no to yes is the software
  - If you have an older gantry chain it is replaced
- Extra if you want gating with your upgrade
- If not all linacs in a center are upgraded
  - Lose the ability to transfer some patients
  - Lose conformal arc on the other machines (for safety reasons)

TPS Upgrade

- Requires new licenses to optimize VMAT
- Requires upgrade computational hardware (if you wish to optimize in less than half a day)

R&V Upgrade

- Requires an installer to come to your site and change a flag from no to yes for each linac upgraded
- Requires an increased annual license fee for this extra service
IMRT QA system upgrade

- May of us moved from Film/Ion chamber to planner arrays
- VMAT QA with planner arrays can be non-optimal and require
  - Extra phantoms
  - Gantry mounts
  - Specialized IMRT QA devices

Increased Linac downtime

- MLCs, gantry and dose must all be coordinated
- MLC components that were able to perform for step and shoot treatments cannot always meet the velocity requirements needed for VMAT
  - Motors
  - T-nuts
- MLC maintenance must be increased
  - Disassembly and cleaning has become frequent since we started VMAT

Longer planning time

- TPS systems that could optimize a 5-8 field IMRT plan in 10-20 minutes may take several hours to optimize a 2 arc VMAT
  - Forces compromise on dose grid
  - Forces acceptance of plans that are “good enough” rather than optimal
  - Requires detailed study of collisions for non-centered targets
Greater Physics QA time

- New QA methods need to be implemented to test the ability of the linac to coordinate MLC, collimator, and gantry motions with doserate
  - If you are lucky the manufacture helps
- New software needs to be written or purchased to analyze the results
- Additional tests need to be done each month (maybe each day)

Theoretical benefits of VMAT:

- Slightly faster treatment delivery
  - Delivery time has been show to be decrease by 50-80% with VMAT. This corresponds to 2-4 minutes
  - This benefit decreases as the number of arcs increase (we have found we often need 3 or 4 arcs to obtain the same plan quality as fixed field IMRT).
  - Total room cycle time
    - Patient transport and changing
    - Setup and imaging
    - Patient availability
  - Auto field sequencing removes much of the time benefit of VMAT since a set of fields can be setup up together

VMAT plans have been shown to be non-inferior

- Studies have show that VMAT plans can be made "as good" as fixed field IMRT
  - In dosimetry studies the 2nd run plan is always better
  - To achieve comparable results we have had to go up to 3 or 4 arcs eliminating the time savings in delivery and costing more calculation time.
  - The extra time requires for VMAT optimization can lead to Dosimetritcs accepting plans that are "good-enough"
VMAT can be inferior to fixed field IMRT

- Fixed field IMRT has more degrees of freedom than VMAT
- **VMAT**
  - MLC leaf speed limitations
  - Gantry speed limitations
  - Dose rate limitations
  - Couch angle and position limitations (including a higher penalty on multiple isocenters)


VMAT may encourage/require moving isocenters away from the target

- Our linac QA is "isocentric"
  - Gantry and collimator angles would need to be accurate to a much tighter level than current recommendations
  - kVp/CBCT/MV image systems would need to be checked at various positions away from isocenter
  - Non-isocentric treatment result in the MLCs having to move across the field during treatment increase the amount of interleaf leakage to normal structures

VMAT may encourage/require moving isocenters away from the target

- Isodose line comparison in VMAT and IS/NSC treatment plans.
Summary (1 of 2)

- ARC therapy has many costs
  - Money
  - Time
  - Maximum Achievable Plan Quality
- ARC therapy has 1 benefit
  - Time

Summary (2 of 2)

- For many patients ARC therapy will result in reasonably quality and quickly deliverable treatments
- For most patients the plans and delivery time will be comparable with fixed field IMRT
  - Especially with auto-field sequencing
- For some patients fixed field IMRT will be superior
  - Tumor locations that are far from the patient’s mid-line
  - Tumors/normal tissues that benefit from non-coplaner beams

"Arc Based Techniques Will Make Conventional IMRT Obsolete"

- ARC Based Techniques may supplement/replace fixed field IMRT for many cases but not all and not any for some institutions with limited resources
- Thus the motion is not supported
Thank You

Each technology has its place

- Fixed field IMRT
- VMAT