Transitioning to TG-142

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Disclaimer: **The slides are only meant to stimulate discussion. The exchange of ideas outside the topics listed in these slides is highly encouraged!!**

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Quick Review

- TG-142 is the most recent task group report on accelerator QA by the AAPM

- TG-142 came out in 2009, to replace portions of the older TG-40 report (which was excellent!)

- Substantial changes include recommendations regarding QA of asymmetric jaws, dynamic and virtual wedges, MLC, IMRT (VMAT) and SBRT tolerances, image guidance methods, respiratory gating, and TBI/TSET

- Recommended tolerances have changed in some cases

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Quick Review

Directly from TG-142

"The recommendations of this task group are not intended to be used as regulations. These recommendations are guidelines for QMPs to use and appropriately interpret for their individual institution and clinical setting. Each institution may have site-specific or state mandated needs and requirements which may modify their usage of these recommendations."

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New Tests

TG-142 New Tests:

- Daily collimator size indicator (does anyone not do this?)

- Daily beam on indicator and door closing safety

- Daily stereotactic interlocks

- Daily check of dynamic/virtual wedge for one angle

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New Tests

TG-142 New Tests:

- Daily check of collision interlocks, imaging and treatment coordinate coincidence, and positioning/repositioning for imaging systems (planar and CBCT)

- Weekly check of MLC match (picket fence)

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New Tests

TG-142 New Tests:

- Monthly check of dynamic/virtual wedge for all energies

- Monthly MLC check to include radiation field, travel speed, and leaf position accuracy at four cardinal angles

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New Tests

TG-142 New Tests:

- Monthly test of imaging and treatment coordinate coincidence at 4 cardinal angles, scaling, spatial resolution, contrast, uniformity, and noise for planar imaging systems

- Monthly tests of HU consistency, geometric distortion, spatial resolution, contrast, uniformity, and noise for CBCT

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New Tests

TG-142 New Tests:

- Annual flatness and symmetry change from baseline for large fields (replaces off axis factor constancy)

- Annual electron applicator interlocks

- Annual table angle verification

- Annual in-depth check of dynamic/virtual wedges

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New Tests

TG-142 New Tests:

- Annual check of MLCs to include transmission, leaf position repeatability, MLC spoke shot, light/x-ray field, Dynalog analysis of segmental and dynamic IMRT delivery

- Annual tests of imaging dose for all imaging methods. Also SDD for EPID imaging and beam quality/energy for kV imaging

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Observations

Annually	
MLC transmission (average of leaf and interleaf transmission), all energies	±0.5% from baseline
Leaf position repeatability	±1.0 mm
MLC spoke shot	≤1.0 mm radius
Coincidence of light field and x-ray field (all energies)	±2.0 mm
Segmental IMRT (step and shoot) test	<0.35 cm max. error RMS, 95% of error counts <0.35 cm
Moving window IMRT (four cardinal gantry angles)	<0.35 cm max. error RMS, 95% of error counts <0.35 cm

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Observations

Can anyone confirm changes in MLC transmission (interleaf and intraleaf leakage)?

allow for subpixel precision to detect changes in discrete locations of an acquired image.[69,70] As treatment planning parametrization seeks a global value for leaf transmission, it is important that the leaf body, side, and end characteristics do not change over time, the most vulnerable being the leaf side rigidity due to leaf inderdigitation, as it may affect interleaf leakage, hence the close attention needed. Leaf position repeatability, MLC spoke shot, and coincidence of light field and x-ray field all are tests intended to check the alignment of the MLCs. Vendor-specific tests are also recommended depending on the model of MLC used. Each vendor has unique preventative maintenance program recommendations and therefore replacement of MLC motors and leaves may vary in frequency. Therefore physicists must be aware of the replacement schedule as post-testing is required. All

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Observations

What Varian says about Dynalog analysis for step-and-shoot fields.

It appears that the Dynalog analysis may be difficult to interpret if you create your own test.

Comments or suggestions??

At this instant in time, the following occurs:

- Leaf position deviations are equal to the distance between the current actual leaf positions (which were the *old* expected positions) and the newly calculated expected leaf positions.
- Beam hold-off has been asserted.
- Beam hold-off instruction has not yet been delivered to the Clinac, and so the beam is still on.

The DynaLog file record for this instant records the following:

- Beam hold-off = 1 (Yes) or = 2 (during LFIMRT carriage group transitions)
- Beam on = 1 (Yes)
- Actual leaf positions equal to the *old* positions
- Expected leaf positions equal to the *new* positions

Note: Even if the dynamic leaf tolerance is not exceeded, these *transition values* are still relatively large.

The DFV includes all DynaLog file data points with beam on = 1 in its calculations, and so these transition points are always included. The result is that, at each transition point, leaf deviation values equal to the intended incremental movement of the leaf—relatively large values—are included in the statistical calculations.

It is important to understand that under this normal operation of the MLC, these transition-point deviations are always included in the statistical results calculated by DFV.

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Beyond TG-142, what are we missing?

Recommendations on any useful tests and examples where problems found are welcome!

- Daily IMRT type delivery
- Daily image quality
- MLC leaf travel speed
- Dynamic wedges
- Light/radiation field accuracy when light field not used…do you test jaws, MLCs, both, neither
- Monthly radiation gantry spoke test
- EPID or other filmless testing methods

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A little help

Will someone relate their experience with implementing QA for respiratory gating?

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Thanks!