HACKETTSTOWN REGIONAL MEDICAL CENTER
JOAN KNECHEL CANCER CENTER
MONTHLY QA LINEAR ACCELERATOR

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SCOPE

Department Of Radiation Oncology

PURPOSE

To ensure a safe and accurate operation of all mechanical and dosimetrical aspects of the Linear Accelerator.

DEFINITIONS

Qualified Medical Physicist – A board certified medical physicist who is qualified to perform QA procedures for linear accelerators and treatment simulators and is registered as such in New Jersey State.

Isocenter – a point of intersection of the collimator axis and the gantry axis of rotation.

Monitor Unit (MU) – a unit of measurement of machine output of a linear accelerator.

POLICY

The Qualified Medical Physicist to perform the following tests monthly. Any items out of tolerance are to be corrected. The medical physicist is responsible for determining corrective action necessary, performing such corrective action and documenting corrective action. Tolerances quoted are as per AAPM TG40, Stated values represent action levels at HRMC. All data for the mechanical & safety checks are summarized in the Monthly QA report.

PROCEDURE

A. Mechanical and Safety Checks

1. Laser Alignment

Procedure: Check Left and right lasers, in both horizontal and vertical direction against wall marks. To check sagittal and ceiling lasers set up & level MedTec IsoAlign on couch. Level device and align crosshairs on side panels using the left and right wall lasers. Set a 20x20 cm field size and align device in lateral direction using crosshairs. Check sagittal laser versus crosshair on device. Rotate gantry 45 off vertical and, while blocking the sagittal laser, check transverse and radial ceiling laser versus cross-hair on jig If machine has backpointer, rotate gantry to 180 and check laser versus IsoAlign.
Tolerance: 2mm

Corrective Action: If out of tolerance adjust lasers back to wall marks. If out of tolerance adjust lasers using IsoAlign as reference   If out of tolerance adjust lasers using IsoAlign as reference

2. Optical Distance Indicator

Procedure: With IsoAlign still in place Turn on ODI take reading at surface for 100SSD. Position IsoAlign block on surface of device, read ODI on top surface of block for 90SSD reading. Remove block, Rotate IsoAlign surface out of the way and place block into lower spot. Read ODI on block surface for 110 SSD reading.
Tolerance: 2mm
Corrective Action: Qualified Medical Physicist to recalibrate ODI, or call service to recalibrate prior to any patient treatment.

3. Gantry Angle Indicator

Procedure: Place a level on the interface mount or on the accessory mount and obtain the true angle for the four orthogonal gantry angles. Check the digital readout.
Tolerance: 2mm
Corrective Action: Qualified Medical Physicist to recalibrate ODI, or call service to recalibrate prior to any patient treatment.
Note: For machines that treat patients at extended distances, e.g. 130 cm, a 0.5° gantry misalignment will appear as a 0.26 cm translation of the isocenter (30cm x tan 0.5°). The calibration of the gantry angle at 0° and 180° should be more stringent, when possible, for these machines.

4. Collimator Angle Indicator

Procedure: Rotate the gantry to 90° or 270°. Place a level on the interface mount or on the accessory mount and obtain the true collimator angle. Check the digital and mechanical readout for the indicated collimator angles.
Tolerance: 1.0°
Corrective Action: Qualified Medical Physicist to recalibrate collimator angle, or call service to recalibrate prior to any patient treatment.

5. Field Size Defined at 100 cm SAD by Light Field Jaws

Procedure: Align graph paper or IsoAlign with crosshairs at collimator angle = 0°, 100cm from the source. Adjust the collimators to match several field sizes covering the clinical range. Record the digital readout. Do this for the upper and lower jaws (in symmetric and asymmetric modes).
Tolerance: Sym. Mode 2 mm or 1% of FS at iso Asym. Mode 2 mm on any side
Corrective Action: Qualified Medical Physicist to recalibrate collimator angle, or call service engineer to recalibrate prior to any patient treatment.

6. Crosshair Centricity at Gantry Angle = 0

Procedure: Set Field Size = 10 x 10 cm^2. Align graph paper or IsoAlign with the collimators at collimator angle = 0°, 100 cm from the source. Record the diameter of the smallest circle, which includes all the crosshair projections at collimator angles of 0, 90°, and 270.
Tolerance: 2mm diameter
Corrective Action: Qualified Medical Physicist to recalibrate crosshairs, or call service engineer to recalibrate prior to any patient treatment

7. Collimator Centricity at Gantry Angle = 0 Jaws

Procedure: Set Field Size = 10 x 10 cm^2. Align graph paper or IsoAlign with the collimators at collimator angle = 0°, 100 cm from the source. Record the maximum deviations of the jaws for collimator angles at 90°, and 270°.
Tolerance: 2mm
Corrective Action: Qualified Medical Physicist to call service engineer to recalibrate prior to any patient treatment.

8. Collimator Centricity at Gantry Angle = 0 MLC

Procedure: Repeat test 8 for the MLC leaf ends and sides.
Tolerance: 2mm
Corrective Action: Qualified Medical Physicist to call service engineer to recalibrate prior to any patient treatment.

9. Light Field and Radiation Field Coincidence

Procedure:

Check that field light is functioning.

Insert XV-2 film 10x12 ready pack into IsoAlign device. Setup IsoAlign device at 100cm SSD. Adjust each jaw independently to match fiducials on device at 15x15, and 20x20 cm field sizes. Insert grid tray for one exposure. Give 30 MU for each field. Open jaws to 22x22cm and deliver an additional 10 MU. Record deviation of light field from radiation field for each jaw at 15 and 20 cm setting.

Tolerance: greater of 2mm or 1%
Field Light Intensity: Func/Non- Func

Corrective Action:
Qualified Medical Physicist to replace field light or call service engineer to replace prior to any patient treatment.

Qualified Medical Physicist to call service engineer to recalibrate prior to any patient treatment.

10. Wedge Position/Latching/Interlock

Procedure:
Align graph paper or IsoAlign with crosshairs at collimator angle = 0°, 100cm from the source. Set collimator to 0°. Wedge in "IN" position. Record the position of the wedge with respect to the crosshairs using the light field and compare to commissioning/annual value.
Confirm that all wedges latch securely and appropriate interlock is displayed on the linear accelerator monitor.

Tolerance: Position 2mm
Latching/Interlock Functioning

Corrective Action:
If out of tolerance Qualified Medical Physicist to check all hardware – mounting screws etc. If problem still persists call service engineer to resolve. Remove wedge from clinical use and alert Medical Director & Cancer Center Director.

If wedge fails to latch or interlock appear Qualified Medical Physicist to call service engineer to repair. Remove wedge from clinical use and alert Medical Director & Cancer Center Director.

11. Grid Tray Position

Procedure:
Use grid deviation relative to crosshairs from L-R coincidence films.

Setup IsoAlign device at 100cm. Measure deviation at isocenter with the light field projections on the IsoAlign, between the machine crosshairs and the tray. Alternatively use film from Test# 9 to assess grid alignment.

Confirm that grid tray latch securely and appropriate interlock is displayed on the linear accelerator monitor
Tolerance: Grid Tray 1mm
Corrective Action: If out of tolerance Qualified Medical Physicist to adjust grid and repeat film to confirm adjustment. If grid tray fails to latch or interlock appear Qualified Medical Physicist to call service engineer to repair

12. Electron Applicator Position/Latching/Interlock

Procedure: Align graph paper or IsoAlign with crosshairs at collimator angle = 0°, 100cm from the source. Find the center of the field with the standard insert (i.e., align the field edges symmetrically about an origin indicated on graph paper, and record the deviation of the field center from the projected crosshairs. Compare to commissioning/annual value. Confirm that all applicators latch securely and appropriate interlock is displayed on the linear accelerator monitor.
Tolerance: 2mm deviation from baseline Latching/Interlock Functioning
Corrective Action: If out of tolerance Qualified Medical Physicist to check all hardware. If problem still persists call service engineer to resolve. Remove applicator from clinical use and alert Medical Director & Cancer Center Director. If applicator fails to latch or interlock appear Qualified Medical Physicist to call service engineer to repair. Remove applicator from clinical use and alert Medical Director & Cancer Center Director

13. Emergency Off Switch

Procedure: Press one emergency off switch per month. Rotate through all switches in treatment room.
Tolerance: Functional

Corrective Action:
If switch is not functioning call service engineer to repair. Alert Cancer Center Director that switch is not functioning. Mark switch as not functioning. Repeat test until functioning switch is tested.

14. Daily Checks

Procedure:
Physicist to sign off on Daily checks periodically.

Tolerance: Pass/Fail

Corrective Action:
Resolve any outstanding issues.

15. Couch Position Indicators Accuracy

Procedure:
Setup IsoAlign device at 100cm. Device should be set up with the rotation axis along the long axis off couch (aligned in radial direction). Known displacements are made in the lateral, longitudinal and vertical directions using the scribed marks on the IsoAlign device. The digital readout is noted.

Tolerance: 2mm

Corrective Action:
Qualified Medical Physicist to recalibrate couch along that particular axis or call service engineer to recalibrate prior to any patient treatment

17. Light Field Defined MLC Field Size.

Procedure:
Align graph paper with cross hairs at 100cm. Apply user MLC file from MLC folder

Tolerance: 1mm

Corrective Action:
Qualified Medical Physicist to call service engineer to recalibrate MLC.

18. Laser Alignment in CT room

Procedure: Turn on Lap computer and push "Zero Position" button. Push red button "LAP" on a pendant. Set MT-TG66 device on CT coach using lasers and a digital level. Check wall lasers position vs. device marks. Move coach inside the bore to match device marks with the inside lasers, zero CT coach position and retract it until device marks match with the ceiling laser. New coach coordinate should be 510.0 cm.
Tolerance: 1mm
Corrective Action: Qualified Medical Physicist adjusts lasers if needed.

B. Monthly Dosimetry Checks.
Reporting form is Monthly Dosimetry Checks Excel Spreadsheet

1. Output Constancy Photons & Electrons

Procedure: Set solid water phantom to 100 cm SSD making sure the crosshairs are aligned. Deliver 100 MUs with ionization chamber at 10cm depth for 6MV and 15MV photon energies and appropriate dmax for electron energies. Use Monthly QA Excel spreadsheet to calculate dose.
Tolerance: 2%
Corrective Action: Tweak as necessary.

2. Backup Monitor Constancy

Tolerance: 2%
Corrective Action: – Tweak as necessary.

3. Energy Check

Procedure: See Monthly QA Excel spreadsheet for set up geometry and requisite build up thickness.

Tolerance: 2%
Corrective Action: Report to Vendor Service Engineer who will make the necessary adjustments.

4. Flatness/ Symmetry Constancy

Procedure: Set up Profiler with the appropriate build up at 100 SSD on the surface. Measure axial and transverse flatness and symmetry for all energies.

Tolerance: Constancy Electrons 3% Symmetry 3%
Corrective Action: Report to Vendor Service Engineer who will make the necessary adjustments.

5. Enhanced Dynamic wedge profiles

Procedure: Set up Profiler with the appropriate build up at 100 SSD on the surface. Measure Enhanced dynamic Wedge profiles using special EDW files and compare with baseline measurements.
Tolerance: 1% in low gradient area
Corrective Action: Report to Vendor Service Engineer who will make the necessary adjustments.

REFERENCES

AAPM TG40 – American Association of Physicists in Medicine Task Group 40 “Comprehensive QA for Radiation Oncology”, 1994.