IMRT BENCHMARK

This IMRT benchmark has been accepted by all of the NCI funded cooperative groups and Quality Assurance Offices as a minimum standard for an institution to be credentialed for use of IMRT in clinical trials. The benchmark is not site specific, i.e. it applies to IMRT treatment of all disease sites. The benchmark should be submitted to the Image Guided Therapy QA Center (ITC).

BENCHMARK CASE:

The benchmark requirement can be satisfied in two ways. The institution may irradiate a specially designed IMRT phantom which is available from the Radiological Physics Center (RPC). The phantom will be CT scanned, planned for IMRT treatment following RPC guidelines, and irradiated to deliver the dose as planned. The TLDs and radiochromic film will be returned with the phantom to the RPC for analysis. (Please note: Irradiation of the RPC phantom is required by some protocols.)

Alternatively an institution may create its own benchmark case using one of its own patients based on the guidelines below.

BENCHMARK GUIDELINES

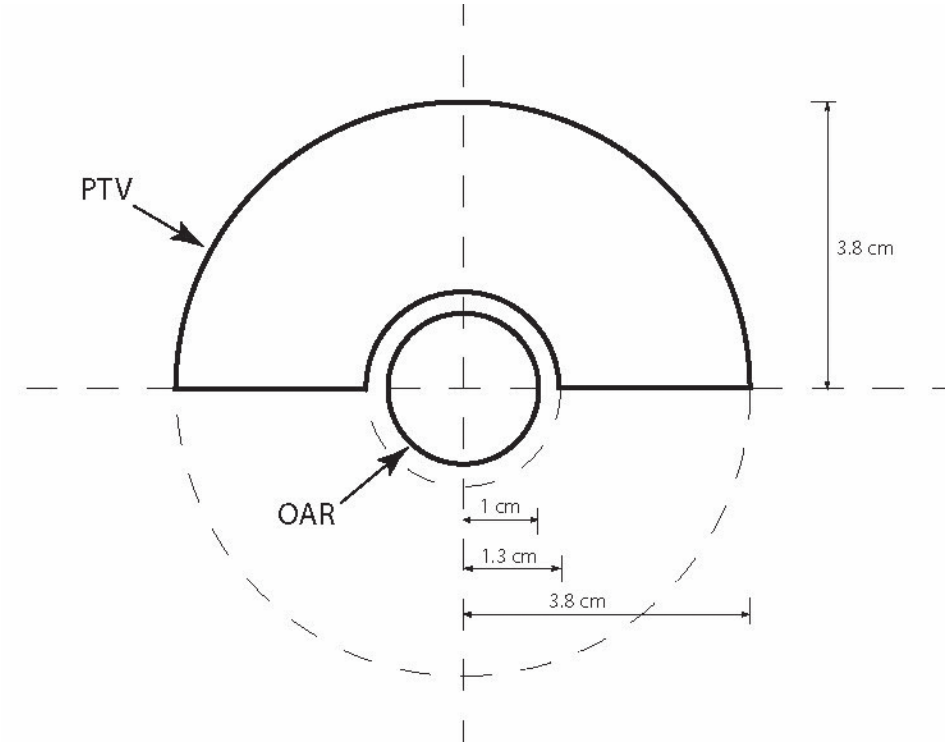
I. Guidelines for the RPC phantom can be obtained from the RPC. (http://rpc.mdanderson.org)

II. Guidelines for institution specific benchmark:

Patient Data Selection:

For the benchmark case, a planning CT scan in the head region or in the pelvic region from your institution shall be used. The image data set shall extend at least 10 cm superiorly/inferiorly with slice thickness no greater than 3 mm. The geometry of the target volume (PTV) and the organ at risk (OAR) to be included is described below. The benchmark case must be planned with a planning system that is capable of transferring a patient's beams to a QA phantom ("hybrid plan"). Measurements are to be made on the QA phantom. If your planning system does not have this capability, contact the ITC for guidance.

The primary organ at risk (OAR) is a central (midplane) cylinder 2.0 cm in diameter which extends at least 5 cm caudad/cephalad. The planning target volume (PTV) to be treated is a half annulus 2.5 cm wide that has the same center as the OAR and surrounds the cylinder by 180 degrees. It too shall extend at least 5 cm caudad/cephalad. There shall be a 3 mm separation of the PTV and OAR. In other words, the annulus has an inner radius of 1.3 cm and an outer radius of 3.8 cm.



For "step and shoot" and "sliding window" techniques the treatment plan shall consist of beams from at least 4 and not more than 9 gantry angles. Tomotherapy arc treatments shall be delivered in the usual way. All beams shall be coplanar in the plane of the axial slices; i.e. the patient's longitudinal axis must be parallel to the gantry's rotational axis.

Desired Dose Distribution:

The aim of the plan is to deliver the prescribed dose of 200 cGy per fraction to 100% of the PTV and not more than 120 cGy (60% of the prescribed dose) to 5% of the organ at risk (OAR). The constraint on the organ at risk has priority over the target volume coverage. That is, the constraint of no more than 60% of the prescribed dose to 5% of the OAR shall be achieved. To accomplish the OAR constraint, target volume (PTV) coverage may be sacrificed if necessary. The maximum dose to any point within the irradiated volume should be no more than 120% of the prescribed dose. If the plan is reported in relative dose, the normalization shall be stated explicitly.

Dose Calculations:

Dose distributions shall be calculated on every axial slice through the PTV and OAR. Isodose distributions may be in absolute dose or in terms of relative dose. If represented in terms of relative dose, the conversion to absolute dose must be clearly described. Dose volume histograms for the PTV and the OAR shall be calculated. In addition, a DVH for "unspecified tissue" shall be calculated. Unspecified tissue is defined as tissue contained within the skin, but which is not otherwise contained within delineated structures.

Dose Verification:

The calculated dose distribution shall be transferred to the QA phantom.
Absolute dose shall be verified as routinely performed at the institution.
The relative dose distribution in the QA phantom shall be measured in at least one plane (presumably with film). The measured plane(s) shall correspond to plane(s) calculated in the planning software and the beams shall be delivered in the geometry of the treatment. That is, couch, gantry, and collimator angles shall be as for the patient.
If the institution routinely verifies dose in other than the true geometry of the patient, this verification shall be performed, analyzed, and submitted.

Material to be Submitted:

Planning Dosimetry

1. Copies of representative axial CT slices of the patient through the target and OAR shall be submitted. The PTV and the OAR shall be shown. The dose distribution shall be superimposed.

2. Copies of the dose distribution calculated in the QA phantom at the plane(s) which is (are) measured.

3. Dose volume histograms for the PTV, OAR, and unspecified tissue.

4. Printouts with a description of all beam parameters.

5. Explicit statement of the normalization of the plan if presented in relative dose.

Verification Dosimetry

1. Isodose distributions on the same scale and values as the dose distributions in #2 above shall be provided from the film dosimetry. Identification of and correspondence of the QA phantom plane and dose distribution and patient plane (and dose distribution) must be explicit.

2. A complete description of the method used to compare the calculated with the measured isodose distributions must be included.

3. A complete description of the method you used for analyzing your measured data, including answers to the following questions, if appropriate:

- type of film used for verification
- type of film scanner used

4. If a beam geometry other than the patient treatment geometry is routinely used for your verification, these results, including analysis, shall be submitted as well.

5. A detailed description of your verification procedures for absolute dose. Measurements performed with an absolute dosimeter shall be described in detail and the results for this case reported.

Please return completed forms and supporting documents to the ITC:

Image Guided Therapy QA Center.
4511 Forest Park Ave., Suite 200
St. Louis, MO 63108
Phone: (314) 747-5415
FAX: (314) 747-5423
Email: itc@castor.wustl.edu

NOTE: A change in IMRT planning system (but not version number) from that listed here or a change in IMRT technique (i.e. step and shoot, sliding window, tomotherapy) requires submission of a new benchmark.