

Package 11

INSTRUCTION SHEET, DATA SHEET AND RESULTS REPORTING FORM FOR THE STEP 8 AUDIT

This package contains the following forms:

Instruction Sheet for film quality audit for relative dosimetry of photon beam single IMRT field;

Data Sheet for film quality audit for relative dosimetry of photon beam single IMRT field;

Certificate for the step 8 audit;

Film preparation and analysis instructions for DANs;

Film handling instructions for DANs.

**ADVANCED TECHNOLOGY IN RADIOTHERAPY: DOSE DELIVERY
QUALIT AUDIT FOR HIGH ENERGY X RAY BEAMS**

INSTRUCTION SHEET

Step 8: Film quality audit for relative dosimetry of photon beam single IMRT field

Please irradiate the TLDs during the period:

and return the package to the address given in the covering letter. Timely response will improve the accuracy of your results.

GENERAL INSTRUCTIONS

A sheet of radiochromic film is supplied for irradiation.

1. Prepare institution's solid phantom (typically ≥ 30 cm \times 30 cm slabs, ≥ 20 cm thick) and CT-scan it.
2. Calculate a highly modulated IMRT treatment field orthogonally for the delivery to the phantom as given in the Technical Instruction (Section B). It is advisable to use the same treatment unit as in the step 7 audit and the photon beam energy most often used clinically for IMRT treatments.
3. Position the solid phantom at 100 cm SAD with the film at 5 cm depth.
4. Deliver the field to the phantom the required number of times to achieve approximately 6 Gy maximum dose to the film.
5. Fill in the Data Sheet. An evaluation of the film results is only possible if this form is complete.
6. Return the irradiated radiochromic film to the [DAN] for analysis within ONE WEEK after the irradiation.
7. Electronically submit DICOM-RT dose data of the film plane (5 cm depth in the phantom) to the [DAN].

SPECIAL NOTE

The radiochromic film should be kept in a sealed envelope to avoid excessive exposure to UV light. Please protect the film from accidental irradiation, heat and excessive humidity during storage. Do not store film in a place where accidental exposure to radiation could occur.

CONFIDENTIALITY

The film results of individual centres are kept confidential by the [DAN] staff and will not be disseminated without the written permission of the participating radiotherapy centre. Anonymous results may be published; statistical distributions/aggregate results may be reported to the relevant authorities.

The TLD equipment sent to you represents a significant investment in cost, time and effort to the [DAN]. Failure to return the TLDs may be reported to your local authorities.

TECHNICAL INSTRUCTIONS

A. Aim of the film quality audit of single field IMRT relative dose delivery

The purpose of this audit is to verify transfer of an IMRT treatment field to the treatment unit, delivery of the treatment field, and agreement between the relative dose distribution delivered and that calculated by the treatment planning system. The extension of the [DAN] programme to this relative dose delivery audit provides an intermediate step between the step 7 audit and a complete end-to-end verification of an IMRT treatment delivery. This audit is designed only for fixed angle IMRT delivery, not VMAT delivery.

B. Preparation of the phantom and the treatment plan

1. Perform a CT scan of the hospital's large homogeneous solid phantom (typically ≥ 30 cm \times 30 cm slabs, ≥ 20 cm thick), or virtually create this phantom in the treatment planning system.
2. Select a highly modulated single treatment field from a recent typical inverse planned IMRT head and neck (H&N) cancer treatment. If your hospital does not use IMRT for H&N treatments, select a highly modulated IMRT field from a different anatomical site.
3. Recalculate the IMRT treatment field onto the homogeneous phantom. Either select a field with orthogonal incidence on the top of the phantom or alter the planned field gantry angle to achieve orthogonal incidence. Make sure the treatment field isocentre is located approximately in the film centre.
4. Calculate the maximum dose in the plane at 5 cm depth in the phantom, with the phantom positioned at 100 cm SAD.
5. Calculate the number of times needed to deliver the plan such that a maximum dose of approximately 6 Gy is given to the plane at 5 cm depth in the phantom. The field should be delivered repeatedly rather than scaling up the number of MUs to ensure that the MLC leaf speed remains clinically relevant.

C. Irradiation of the radiochromic film

1. Position the phantom on the treatment couch at 100 cm SAD.
2. Place the film at 5 cm depth in the phantom. Align the film marks to the isocentre. Ensure that the gantry indicating label is appropriately aligned.

NOTE: Fingerprints can affect the film. Use gloves or caution to not touch the surface of the film.

3. Deliver the treatment field the appropriate number of times.
4. Put the irradiated radiochromic film back to the envelope for returning it to the [DAN].

D. Film and data submission instructions

Make sure to submit the following to the DAN:

1. Irradiated film.
2. Calculated DICOM-RT or TPS dose distribution of the film plane of the treatment field in an electronic format using Internet.
3. The completed datasheet.

ADVANCED TECHNOLOGY IN RADIOTHERAPY: DOSE DELIVERY
QUALITY AUDIT FOR HIGH ENERGY X RAY BEAMS

DATA SHEET

Step 8: Film quality audit for relative dosimetry of photon beam single IMRT field

Individuals responsible

Radiation oncologist

name *position*

Medical physicist

name *position*

Name of institution

Address

Telephone number

Fax number

E-mail

Form completed by

Name

Position Medical physicist Radiation oncologist Technician
Other:

On the day

| | | | | | |
|------------|--------------|-------------|--|--|--|
| | | | | | |
| <i>day</i> | <i>month</i> | <i>year</i> | | | |

TLD irradiation performed by

Name

Position Medical physicist Radiation oncologist Technician
Other:

Previous participation in an external audit or inter-institution comparison for this beam

No

Yes Date

Please also give information on participation in any other audit

[DAN LETTERHEAD]

RESTRICTED

STEP 8: FILM QUALITY AUDIT FOR RELATIVE DOSIMETRY OF PHOTON BEAM SINGLE IMRT FIELD

Institution *Institution Name*
Address: *institution Address*
Country: *Country Name*

Irradiation done by: *Family Name*
Radiation unit and beam *Name of the Radiation*
used: *Unit*
MLC used: *MLC Model*
TPS used: *TPS Model*
Evaluation: *yyyy-mm-dd*

RESULTS OF SINGLE FIELD IMRT TEST

Gamma analysis was used to compare the TPS dose distributions and those from the irradiated film. The gamma analysis parameters can be seen in Table 1. *[Film type]* films were scanned with an *[Scanner model]* scanner and a *[Software model]* software was used for the analysis. The dose difference map and the isodose map of the evaluated area can be seen in Figs 1 and 2. The dose distributions were normalized to the maximum dose.

TABLE 1. THE PARAMETERS AND THE RESULTS OF THE GAMMA ANALYSIS

| Gamma analysis | |
|-----------------------|---------------|
| Pass level criterion: | 3%; 3 mm |
| Threshold: | 20% |
| Acceptance limit: | 90% |
| Passing rate: | 99.16% |

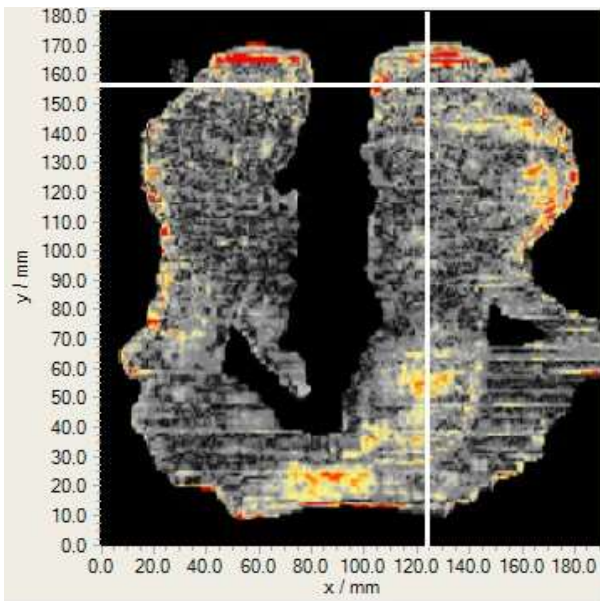


Figure 1. Dose difference map between the TPS plan and the irradiated *[Film type]* film. The axes cross at the reference (normalization) point.

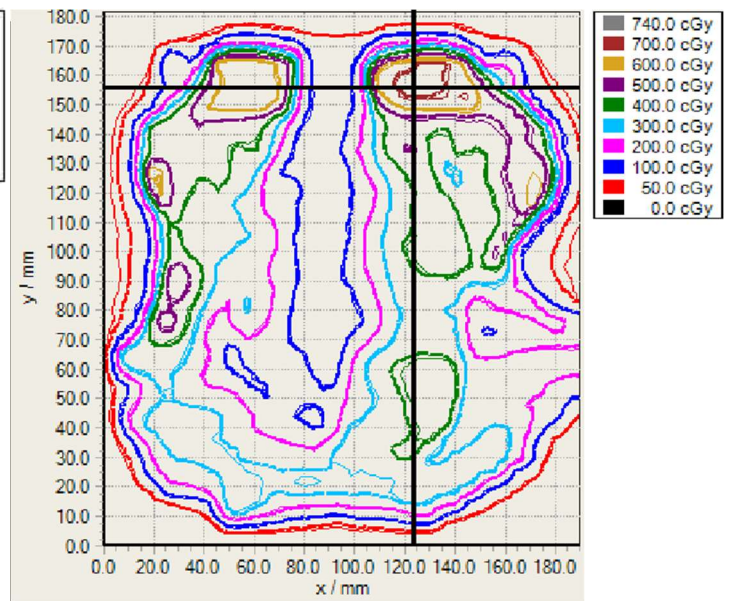


Figure 2. Isodose map with thick lines corresponding to TPS and thin lines to film measured isodoses. The axes cross at the reference (normalization) point.

Date:
yyyy- mm-dd
Signature

STEP 8: FILM QUALITY AUDIT FOR RELATIVE DOSIMETRY OF PHOTON BEAM SINGLE IMRT FIELD

Institution: *Institution Name*
Address: *institution Address*
Country: *Country Name*

Irradiation done by: *Family Name*
Radiation unit and beam used: *Radiation Unit*
MLC used: *MLC Model*
TPS used: *TPS Model*
Evaluation: *yyyy-mm-dd*

RESULTS OF SINGLE FIELD IMRT TEST

The vertical and the horizontal dose profiles along the axes passing through the reference point are shown in Figs 3 and 4. The agreement criterion between the relative points from the profiles is \times % of the reference dose in the low dose gradient regions and $\pm y$ mm distance to agreement in the high dose gradient regions.

Vertical profile



Figure 3. Vertical profile along the axis passing through the point of the reference dose.

Horizontal profile

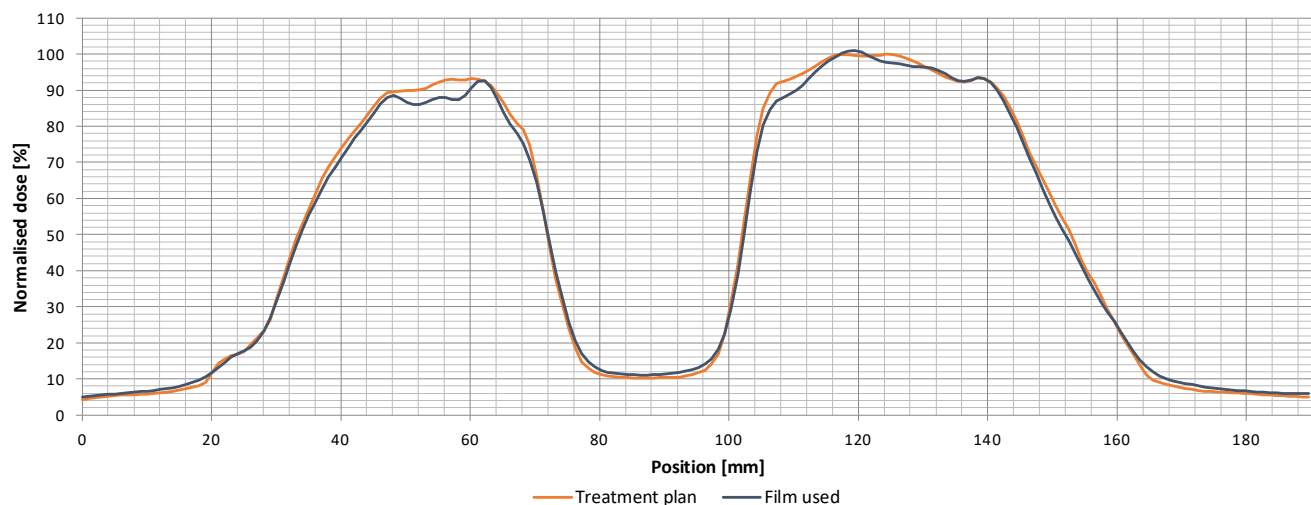


Figure 4. Horizontal profile along the axis passing through the point of the reference dose.

INSTRUCTIONS FOR DANS

ADVANCED TECHNOLOGY IN RADIOTHERAPY: DOSE DELIVERY QUALIT AUDIT FOR HIGH ENERGY X RAY BEAMS

FILM PREPARATION AND ANALYSIS

Step 8: Film quality audit for relative dosimetry of photon beam single IMRT field

GENERAL INSTRUCTIONS

Before sending the radiochromic film to the participating hospital

1. Use the Film Handling Instructions below for film preparation.
2. Label and mark the film.
3. Pack the film, quality audit instructions and data sheets, and send them to hospital.

Upon receipt of the film and electronic treatment planning data from the hospital

1. Scan the film.
2. Compare film dose distribution to treatment planning system calculations.
3. Provide the report to hospital indicating the results of relative dose agreement.

TECHNICAL INSTRUCTION

A. Before sending film to hospital; radiochromic film preparation procedures:

1. The [DAN] should note the batch of the film being used (so that the appropriate calibration curve is used).
2. The entire 20 cm × 25 cm film sheet will be needed for this quality audit.
3. Mark the radiochromic film with a label “toward gantry” in the top right hand corner which will indicate the correct orientation of the film in the phantom. Also add four orthogonal alignment marks at the edges of the film that will define the centre of the film and will be used by the hospital to align the film to treatment isocentre.
4. The sheet of radiochromic film, quality audit instructions and data sheet will be sent to the participating hospital.

B. Upon receipt of the film and electronic treatment planning data from the hospital

1. The radiochromic film returned to the [DAN] should be labelled with:
 - a). Hospital name
 - b). Date of irradiation
- NOTE. Keep writing at unexposed areas or at the edge of the film.*
2. Handle and store the film (see the Film Handling Instructions below) until it is analysed. The film storage envelopes must also be labelled with hospital name and date of irradiation.
 3. As with all films (e.g., calibration films), scan this film in a consistent orientation.
 4. Calibrate the film (follow the Film Handling Instructions below). This should be based on a batch-specific calibration curve created by the DAN for the film used in this audit step.
 5. Load the treatment planning system dose calculation of the film plane into the gamma analysis software.
 6. Register the measured and calculated dose distributions. The centre of the film (as per the marks) corresponds to the treatment isocentre.
 7. Normalize the measured film distribution to the calculated dose distribution at a point in a high dose, low gradient region.
 8. Perform gamma analysis on the dose distributions using a 3%/3mm criterion over all pixels above 20% of the maximum dose; 90% of pixels should pass this criterion.
 9. Compare the measured versus calculated dose profiles along the two major orthogonal axes passing through the isocentre. See examples in Figs 1 and 2.
 10. Prepare a report for the participating hospital.

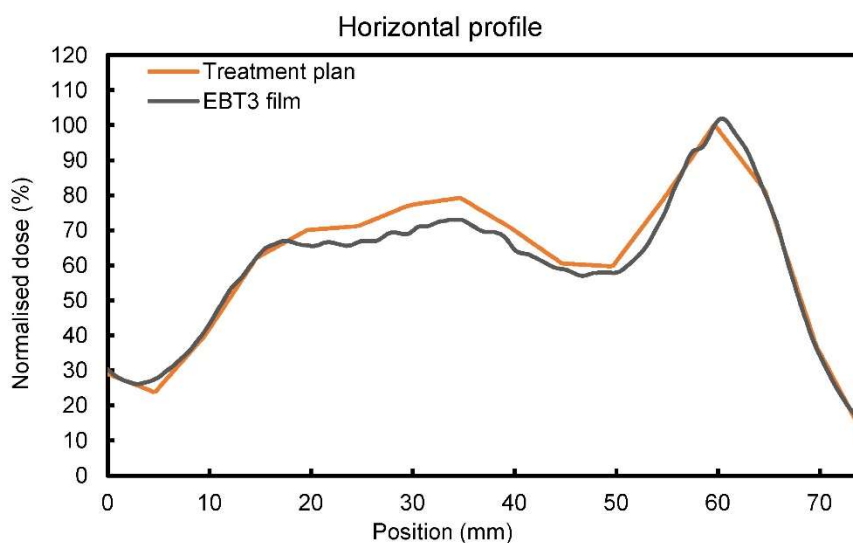


FIG. 1. Horizontal profile along the axis passing through the point of the reference dose.

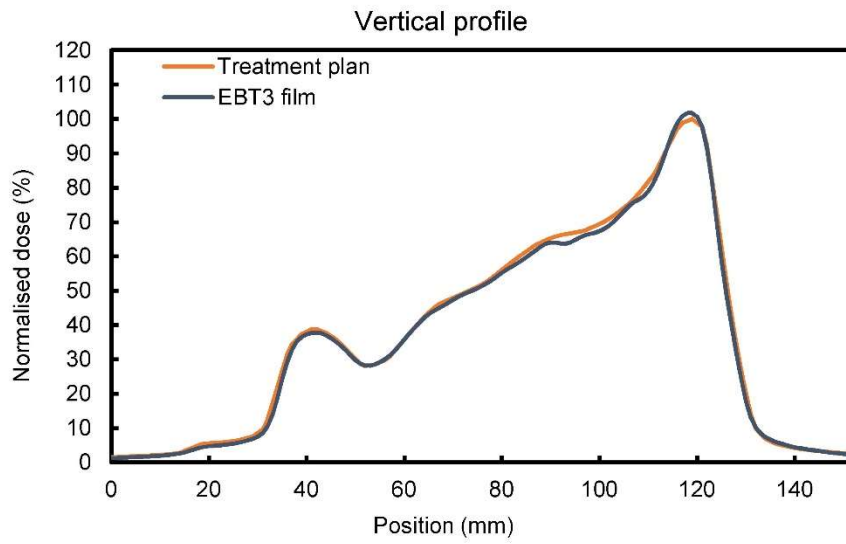


FIG. 2. Vertical profile along the axis passing through the point of the reference dose.

INSTRUCTIONS FOR DANS

ADVANCED TECHNOLOGY IN RADIOTHERAPY: DOSE DELIVERY QUALITY AUDIT FOR HIGH ENERGY X RAY BEAMS

FILM HANDLING INSTRUCTIONS

Step 8: Film quality audit for relative dosimetry of photon beam single IMRT field

GENERAL GUIDANCE

1. The DAN will store, prepare, load the phantom, ship, and receive the radiochromic films.
2. The DAN/FMC will scan and analyze the radiochromic films.
3. Radiochromic film should be stored in such a manner as to avoid accidental irradiation, heat (e.g. sunshine), exposure to UV light and excessive humidity. The film should be kept in a cool and dark location.
4. Radiochromic film must not be handled with bare hands. Cotton gloves must be worn when touching the film. In addition, the film should not be folded or damaged mechanically, as that will cause artefacts to appear when scanning irradiated films.
5. Further detailed information can be found in the AAPM's Task Group Report 55, entitled "Radiochromic Film Dosimetry".

TECHNICAL GUIDANCE

Radiochromic film preparation procedures:

1. The DAN should note the batch of the film being used to ensure the correct calibration curve is applied.
2. The film needed for the single IMRT field will be a full size sheet of radiochromic film.
3. When the film returns from the hospital, it will be handled and stored as described in the general guidance section.

Radiochromic film calibration procedures:

1. Once for each batch of film, a film calibration curve must be generated. If film from a new batch is used, a new calibration curve must be established and applied.
2. A new calibration curve should be generated (even within the same batch) at least regularly enough that the currently applied curve remains valid.
3. The calibration curve should be generated according to software manufacturer's instructions over a dose range of 0-10 Gy using a beam energy appropriate to this audit (typically 6 MV).