IMRT Prostate Planning

5 Field IMRT
Either 74Gy in 37#
60Gy in 20# or
57Gy in 19#

Importing CT Scans and Outlining

- CT scans imported into Prosoma for outlining of the PTVs and OARs.
- Clinician outlines Prostate, Prostate and Seminal Vesicles, Rectum, Small Bowel and Urethral Bulb. Physicists outline rectum, bladder, left and right femoral heads. Physicists also “grow” the PTVs along clinical trial guidelines. The PTVs are then checked and approved by the clinician before planning commences.
- There is a PTV1, PTV2, PTV3, PTV1-PTV2 and PTV2-PTV3.
- Prescription depends on grading of the disease based on trial criteria. Patients are designated as high, intermediate or low risk.
- Outlines are exported to Eclipse and all volumes are checked for distortion or truncation during transmission. Any modifications made to the volumes (for example smoothing) are recorded, signed and checked by a second physicist.

Beam Arrangement

- The usual beam arrangement is 5 fields with angles of 180, 260, 300, 40 and 100°. This usually gives good coverage but the anterior oblique beams may be change by up to 5° in some cases (to 325° and 35°).
- Before inserting the beam arrangement from the beam template library, align the position of the isocentre to match the tattoos.
- Insert the IMRT 5-field plan and look at each BEV in turn to ascertain whether the isocentre is near the centre of the target volume (PTV1).

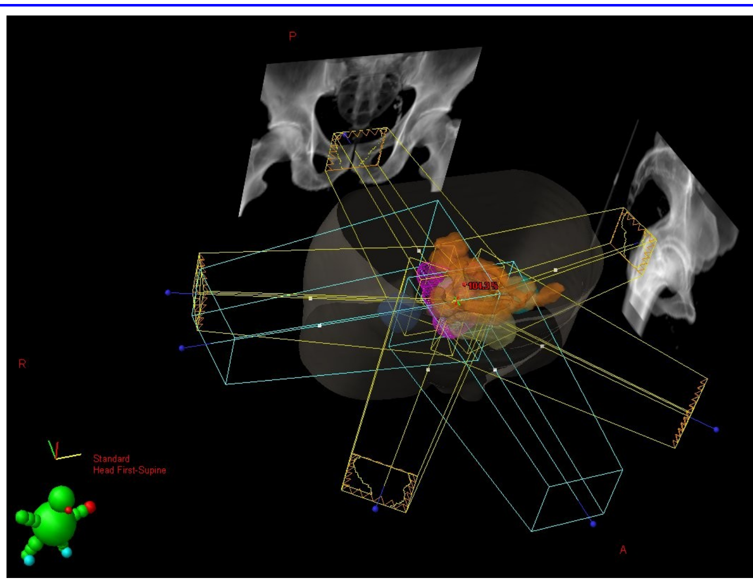

Figure 1: 5 Field IMRT beam arrangement for prostate treatment

Optimisation Constraints

- Constraints are put on PTV1-PTV2, PTV2-PTV3 and PTV3.
- Use pseudo structures to help shape the isodoses distribution. It is common to use a pseudo bladder and pseudo rectum.
- The constraints below can be used as a first optimisation: (Prescribed dose = 60Gy in 20#)

Structure	Constraint	Volume	Dose	Priority
P1-P2	Upper	0	5790	80
P1-P2	Upper	20	5475	90
P1-P2	Lower	100	5160	90
P2-P3	Upper	0	6050	90
P2-P3	Upper	10	5900	100
P2-P3	Lower	100	5790	100
P2-P3	Lower	50	6000	110
P3	Upper	0	6160	110
P3	Lower	100	6050	120
Pseudo Bladder	Upper	0	5800	70

Table 1: Initial Optimisation Constraints for IMRT Prostate (60Gy/20#)

- For the pseudo rectum, use a dose constraint line created during the optimisation process.
- After successive optimisations, we are looking for 95% isodoses line to cover PTV3, the 91% isodoses line to cover PTV2 and the 76% isodoses line to cover PTV1. Coverage of PTV 1 and PTV 3 are usually easy to achieve but adequate coverage of PTV 2 is more difficult.
- Where coverage of PTV 2 is proving difficult, could add a slice SUP and INF of the PTV2-PTV3 volume. The forces the optimisation to work harder and cover a large volume and after removing the extra 2 slices PTV2 should be well covered by the 91% isodose line.
- When the isodose distribution is satisfactory, look at the DVH graph for the relevant structures. They should all fit the trial criteria. If not, modify the constraints and re-optimise.
- When satisfied with both the isodose distribution and the DVHs check the MUs for each field do not exceed about 200 and ideally should be between 100 and 180 per field. If any fields exceed the MU limit then use fluence editing (sparingly) to reduce the number of MUs. After fluence editing, recalculate the dose for that field and look at the whole dose distribution again for adequate PTV coverage.
- When MU numbers for each field is within limit, look at the Average Leaf Pair Opening and MU Factor for each field in Report (preview). The ALPO should be >2 and as large as possible and the MUF should be close to 1.
- Create an ANT ISO and LT/(RT) LAT ISO field for set-up purposes.
- When dose distribution, DVHs, MU numbers, ALPO and MUF are all ok then the plan write-up can commence to ready the plan for checking by another competent physicist.

Treatment Plan Write Up

- Different centres will have different requirements and the following is only an example of what paperwork is required to be printed with the IMRT plan.
- Two copies of the transverse slice at the isocentre of the approved plan, adjust the windowing to ensure the image is not too dark or light.
- Two copies each of the central sagittal and coronal slices showing the structures but not the fields.
- Two copies of BEV for all fields at 100cm and one copy of the fluences for all fields.
- Two copies of the DVH graphs.
- Into the "clinical" folder insert one copy of the following: transverse, sagittal and coronal slices, BEV for each field and DVH graph.
- Into the "physics" folder insert one copy of the following: transverse slice, fluence for each field and DVH graph.

Creation of verification plans

- Again, different centres will have a different approach to IMRT QC measurements and the following is simply an example of what might be done.
- Create an EPID verification plan. The purpose of this is to use the EPIDs to measure the dose profile of each beam but with the gantry at 0°. The dose plane recorded at the linac will later be compared to the predication from the TPS.
- Create a Phantom verification plan. This is basically a CT scan of a 30 x 30 x 30 cm^3 block of solid water. The final plan from the actual patient anatomy is superimposed onto this and the dose is recalculated. The isodose distribution should be very similar on both.
- From the dose distribution in the phantom, select a chamber position at the isocentre. This may be about 9cm deep in the phantom. The chamber position should be located in a volume of low isodose gradient. A single chamber position is adequate to obtain absolute dose measurements for a prostate plan.
- In addition to the absolute measurement, relative measurements of the isodose distribution may also be made. One approach is to use film at 1 or 2 depths in the phantom at the same time that it is being irradiated to obtain the absolute measurements.
- If the ionisation chamber is placed at 9 cm deep then two suitable planes for the film could be at 8 and 10 cm deep in the phantom.
- Kodak EDR2 or Gafchromic EBT2 film could be used depending on local preference.
- The isodose distribution on the film is digitised using a Vidar scanner for example and compared to the calculated isodose distribution from the TPS using software such as OmniPro™. A gamma analysis is performed on both measured and calculated distributions and a pass rate of >95% is required for 3mm and 3%. A print out is made showing the imported TPS plane, the isodose scanned from the film and the ROI analysed. A separate print out of the gamma analysis histogram showing the pass rate of > 95% is also produced and put in the physics folder for checking.
- Prior to obtaining a relative isodose measurement with the EPID, a "sweep gap" and "fence" test is performed to check the integrity of the MLCs. The QC analysis involves using the Portal Imager in Eclipse to compare the predicted isodose distribution in the EPID with the gantry at 0° to the actual isodose distribution recorded at the linac. Again, a gamma analysis is performed with a dose difference criterion of 3.0% and a DTA criterion of 3.0 mm. The Area Gamma > 1 should be less than 5%.
- A print out is made of each EPID image and put in the physics folder to be checked by another competent physicist.