# SPINAL CORD DOSES IN PALLIATIVE LUNG RADIOTHERAPY SCHEDULES

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In this study, we have audited practice in a large UK oncology centre, to see if the patient selection criteria and radiotherapy techniques used in the trials have been maintained in routine clinical practice.

**We aim to check the safety of the standard palliative radiotherapy techniques by using the Linear quadratic model for a careful estimation of the doses received by the spinal cord, in all standard palliative lung radiotherapy fields and fractionation.**

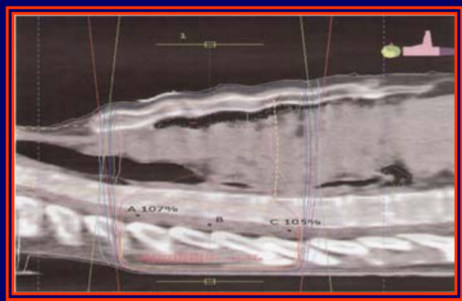
**Material and Methods:** All patients surveyed at this prospective audit were treated with palliative chest radiotherapy for lung cancer over a period from January to June 2005 by different Clinical oncology specialists within the department. Radiotherapy field criteria were recorded and compared with the recommended limits of the MRC trial protocols for the dose and fractionation prescribed.

Doses delivered to structures off the field central axis were estimated using a standard CT scan of the chest. Dose estimates were made using an SLPLAN planning system. As unexpected spinal cord toxicity has been reported after hypofractionated chest radiotherapy, a sagittal view was used to calculate the isodoses along the length of the spinal cord that could lie within the RT field. Equivalent dose estimates are made using the Linear-Quadratic Equivalent Dose formula (LQED). The relative radiation sensitivity of spinal cord for myelopathy (the $\alpha/\beta$ dose) cord has been estimated as $\alpha/\beta$ = 1Gy.

**Saggital image of chest for patient 1, 2 and 3. Doses to the spinal cord estimated at three points from an anterior 120cm2 field: Superior (A), D max (B) and inferior (C).**

***Patient 1***

| **Dose in Gy/ Fraction** | **10/ 1** | **17/ 2** | **20/5** | **36/12** | **39/ 13** |
|---|---|---|---|---|---|
| Eq. Dose in Gy with 2 Gy/ fractions. **$\alpha/\beta$ = 1** (for CNS) | 36.6 | 54 | 33 | 47.9 | 52 |
| D Max 110.6 % | 40.5 Gy | **59.4 Gy** | 36.5 Gy | 53 Gy | **57.5 Gy** |
| Superior point (107 %) | 39.2 Gy | **57.7 Gy** | 35.3 Gy | 51.2 Gy | **55.6 Gy** |
| Inferior point (105%) | 38.4 Gy | **56.7 Gy** | 34.6 Gy | 50.3 Gy | **54.6 Gy** |

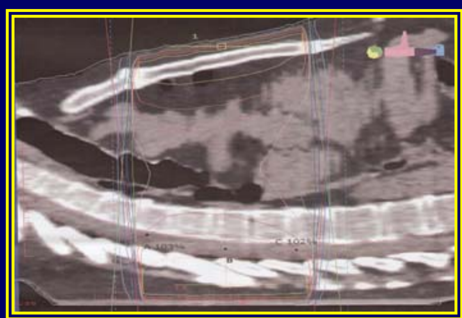



***Patient 2***

| **Dose in Gy/ Fraction** | **10/ 1** | **17/ 2** | **20/5** | **36/12** | **39/ 13** |
|---|---|---|---|---|---|
| Eq. Dose in Gy with 2 Gy/ fractions. **$\alpha/\beta$ = 1** (for CNS) | 36.6Gy | 54 | 33 | 47.9 | 52 |
| D Max 103.7 | 38 Gy | **55.9 Gy** | 34.2 Gy | 49.6 Gy | **53.9Gy** |
| Superior point (98 %) | 35.8 Gy | **52.9 Gy** | 32.3Gy | 46.9 Gy | **50.9 Gy** |
| Inferior point (97%) | 35.5 Gy | **52.4 Gy** | 32 Gy | 46.4 Gy | **50.4 Gy** |


***Patient 3***

| **Dose in Gy/ Fraction** | **10/ 1** | **17/ 2** | **20/5** | **36/12** | **39/ 13** |
|---|---|---|---|---|---|
| Eq. Dose in Gy with 2 Gy/ fractions. **$\alpha/\beta$ = 1** (for CNS) | 36.6 | 54 | 33 | 47.9 | 52 |
| D Max 109.3 % | 40 Gy | **59 Gy** | 36 Gy | 52.3 Gy | **56.8 Gy** |
| Superior point (103 %) | 37.7 Gy | **55.6 Gy** | 34 Gy | 49.3 Gy | **53.5 Gy** |
| Inferior point (102%) | 37.3 Gy | **55 Gy** | 33.6 Gy | 48.8 Gy | **53 Gy** |



Our analysis of the schedules used in current practice in a large regional cancer centre suggest that the 17Gy in 2 fraction and 39Gy in 13 fraction protocol would risk spinal cord damage if the radiotherapist was unaware of the potential spinal cord doses. Both schedules have spinal cord equivalent doses (using the linear-quadratic model) that lie within the conventional safe limits of 50Gy in 25 fractions for the 100% isodose. However when the dosimetry is modelled for a 6MV 100cm isocentric linnac in 3 dimensions, and altered separations and air space inhomogeneity are considered, the D-Max doses consistently fall above this limit on our 3 model patients. The MRC protocol for the 39Gy in 13 fraction schedule advised that posterior spinal cord blocking should be used for the last 2 fractions, to reduce spinal cord dose. No such advice has been given for the 17Gy in 2 fraction protocol. The risk of high D-max areas within the beams increases for a 6MV lineac with patient separation. The effect appears greater when the air gaps of lung and trachea are also considered as in our model patients.

As a result of this risk assessment, we advise caution in the use of 17Gy in 2 fractions or 39Gy in 13 fractions without special consideration. The risks appear greater in larger patient with greater separations, in larger fields or where the separations vary in the saggital plane. Many of our patients required large area palliative radiotherapy fields of greater than 120cm2 (46%), 150cm2 (26.8%) and 200cm2 (7.46%). In these high risk situations, the 10Gy in 1 fraction, or 20Gy in 5 fraction schedules would be predicted to be safer treatment options.