Materials and Methods: We used PCRT v5.08 planner and EMAMI and Quantec tolerance tables for OAR. Ten patients with pancreatic or gastric neoplasm have been chosen, with 45 or 50. 4 Gy treatment dose prescription. All treatments were planned with two types of plans: one with coplanar beams and the other one with non-coplanar and introducing table's turns. Schemes with three beams (anterior and two sides) or four fields in a box were used, depending on the suitability of them in each case. All plans with non-coplanar fields have made a turn table in the anterior beam and some of them, on the sides to fully optimize the kidneys blocked by the multileaf collimator. In any case, leaf conformations are made automatically (with a margin of 5 mm) to avoid the variability introduced by the dosimetrist and that the comparison is valid and reproducible plans. We have also used the same turns of collimator for plans with coplanar and non-coplanar beams. We evaluated a number of indicators to evaluate the goodness of the new technique in an objective manner. In this regard, we have never received doses greater than 107% of the prescribed dose in the PTV of any plans. For the isodose of the 95%, we are trying to get at least 95% for the coberture of the target volume. In the case of kidneys evaluated the mean dose and V15 (%). To evaluate the liver only measures the mean dose.

Results and Conclusions: Our results show that in most of cases there is an improvement in the dose delivered to organ at risk while there isn't luck of coverage of dose in PTV (Table 1). On other hand, this technique involves a higher treatment time delivery compared to standard box techniques.

Table 1

Volume	Right kidney				Left kidney				Liver		PTV	
Unit	V15 (%)		Mean dose (Gy)		V15 (%)		Mean dose (Gy)		Mean dose (Gy)		V95 (%)	
Technique	COP	No COP	COP	No COP	COP	No COP	COP	No COP	COP	No COP	COP	No COP
Mean	28.4	16.9	10.2	8.0	42.1	30.7	14.0	11.8	17.4	16.8	98.8	99.0

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Volume Dose Prescription in Stereotactic Body Radiotherapy for Lung Cancer

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Background: 3D treatment planning system and dose-volume calculations are commonly used now and the dose prescription method is changing. The reference point dose was recommended for prescription, however, volume dose is becoming popular for IMRT and also for 3D-CRT. In stereotactic body radiotherapy (SBRT), PTV for early stage lung cancer usually includes low density lung field area around tumour volume. Because of that, the periphery of PTV tends to receive relatively lower dose even with appropriate leaf margin of 5 mm.

Material and Methods: We analyze dose distributions in four cases with lung cancer treated by SBRT. We calculated dose distributions with Xio 4.5 using superposition algorithm. PTV margin was added 5 mm around CTV, and leaf margin of 3 to 5 mm was also added for SBRT. We prescribed by isocenter dose in clinical practice. We compared doses for CTV with those for PTV. We also moved isocenter by 5 mm, which is the same as PTV margin, to 6 directions and the same dose comparison was made in each movement.

Results: D95, minimum dose (DMin), and mean dose (DMean) for PTV were 89.5, 80.2, and 96.0% of the prescription dose on an average respectively, and they were lower than those for CTV, that were 95.9, 92.8, and 98.9%. With the shift of isocenter, D95, DMin, and DMean for CTV were reduced to 94.5, 88.5, and 98.5% on an average respectively, which were still much higher than those for PTV. Even though the reduction of CTV dose was largest, DMin was an average of 85.7%, when isocenter moved to cranial and caudal direction, it was higher than that of PTV dose of 80.2%.

Conclusions: If we add appropriate leaf margin around PTV, the dose reduction for CTV by isocenter shift in the range of PTV margin was relatively small. Therefore, It is not considered essential to cover the whole PTV by high dose volume when sufficient margin is added around CTV.

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Comparing Volumetric Intensity Modulated Arc Therapy With Multiple Static Field Radiosurgery for Brain Metastases

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Background: Stereotactic radiosurgery (SRS) is an effective treatment for oligometastases in the brain. Multiple static field (MSF) techniques can achieve excellent dose conformity and rapid dose fall-off outside the target but are resource intensive with long treatment times if 2 or more lesions are treated. Arc therapy offers potentially equivalent or improved dosimetry with shorter treatment times.

Materials and Methods: Linear accelerator MSF radiosurgery or 3−4 field conformal plans for 10 patients with 1, 2 or 3 brain metastases were compared with RapidArc (RA) plans generated using 2 coplanar arcs with a single isocentre. Clinical target volume (CTV) was all tumour visible on MRI with a 3 mm margin applied to generate the planning target volume (PTV). 18−25 Gy was prescribed in a single fraction with 99% of the PTV to receive at least 90% of the prescription dose. Dose constraints of 8 Gy were applied to critical structures (optic nerves, optic chiasm and brainstem). Conformity index for 90% of the prescription dose (CI90%), conformity gradient index (CGIg), mean dose to normal brain and treatment delivery time were compared.

Results: 7/10 patients were female. Mean age (range) was 58.2 (44−66) years. Lesions were metastatic from breast (4), lower gastrointestinal (1), renal cell (2), lung (1) and oesophagus (1) carcinomas and carcinoma of unknown primary (1). 6 lesions were solitary, 2 patients had 2 metastases and 2 had 3 metastases. Combined PTV volume was 7.44 cm^3 (small solitary cerebral peduncle lesion) to 123.11 cm^3 (3 large left cerebral lesions).

RA plans had significantly better CI90% (mean 1.22 vs. 1.56, $p < 0.01$) compared with MSF plans for 7 patients (8 lesions). Dose to normal brain was not significantly different although CGIg was inferior (mean 46.5 vs. 59.4, $p = 0.02$). Treatment time (limited by a maximum dose rate of 600 monitor units per minute) was equivalent for solitary lesions but was approximately half for RA when 2 metastases were treated (21 vs. 43.5 minutes).

For 3 patients (2 or 3 metastases each) RA plans reduced mean dose to normal brain by approximately 50% compared to 3−4 field conformal plans.

Conclusions: RapidArc can be used to treat 1 to 3 brain metastases with SRS. Treatment (and planning) time should be considerably shorter when using RA compared with MSF for 2 or 3 metastases. Reduced dose to normal brain when treating multiple mets with RA versus 3−4 field conformal plans may be clinically significant.

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Confirmation of Internal Target Volume and Dosiology Study for Lung Cancer Using 4D-CT Technology

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Purpose: For the effect of breathing motion, it is difficult to confirm the tumour accurately in lung cancer in the intensity-modulated radiotherapy (IMRT). This study is to confirm the internal target volume (ITV) and compare the volumetric and dosiology differences between 3D-CT and 4D-CT, using 4D-CT technology.

Materials and Methods: Eight patients with primarily lung cancer were enrolled and both 3D and 4D-CT were taken. For each patient, 3D-CT was taken as reference image and clinical target volume (CTV) was defined on it. Extended CTV with setup margin was defined as PTV-3D; for each respiratory phase, CTV were drawn separately and mixed together as ITV, which was extended as PTV-4D. Design different IMRT plans on PTV-3D and 4D separately for each patient with same prescription doses, field degrees and optimization target functions. The differences of target volumes, dose distributions on targets and organs as risk (OAR) were compared.

Results: The volume is 150.67 ± 86.67 cm^3 for PTV-3D and 130.17 ± 79.89 cm^3 for PTV-4D, which is 13.61% (8.51–23.53%) smaller. There is no significant difference of target conformal index (CI) and homogeneity index (HI). About the dose on OARs (including lung, heart and spinal-cord), 4D plans have lower dose to the 3D plans: V5, V10, V20 and V30 for total-lung is cut separately from 41.25%, 29.75%, 21.25%, 13.00% to 38.13%, 27.00%, 17.25%, 9.13%; mean lung dose (MLD) is cut from 1103.63 cGy to 911.21 cGy; mean heart dose is cut from 450.43 cGy to 372.20 cGy; maximum dose for spinal-cord is cut from 3162.83 cGy to 2967.63 cGy.

Conclusions: 4D-CT technology can be used to bridge the gap of missing or extending the target volume on 3D radiotherapy. It will bring better accuracy an lower dose on OARs as well.