Intensity Modulated Radiation Therapy of Brain Tumor

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ABSTRACT

As intensity modulated radiation therapy compared with conventional radiation therapy, tumor target dose increased and normal tissues and critical organs dose reduced. In brain tumor, treatment planning of intensity modulated radiation therapy was practiced in 4MV, 6MV, 15MV X-ray energy. In these X-ray energy, was considered the dose distribution and dose volume histogram. As 4MV X-ray compared with 6MV and 15MV, maximum dose of right optic-nerve increased 10.1%, 8.4%. Right eye increased 5.2%, 2.7%. And left optic-nerve, left eye, optic chiasm and brainstem incrased 1.7% - 5.2%. Even though maximum dose of PTV and these critical organs show different from 1.7% - 10.1% according to X-ray energies, these are a piont dose. Therefore in brain tumor, treatment planning of intensity modulated radiation therapy in 9 treatment field showed no relation with energy dependency.

Key words: Intensity modulated radiation therapy, Energy dependency, Brain tumor

1. ITRODUCTION

As intensity modulated radiation therapy compared with conventional radiation therapy, tumor target dose increased and normal tissues and critical organs dose reduced. Therefore IMRT is able to increase survival and improve life quality. The goal of radiation therapy is irradiated fatal dose in tumor region and irradiated minimal dose in critical organ. Many investigators have effort for conquest these problems.

The result, three dimensional conformal radiation therapy and intensity modulated radiation therapy were developed. Early 1990, These research was started to The Memorial Sloan-Kettering Cancer Center. IMRT was optimized that treatment planner establish to constraint about region and critical organs. In this study, Treatment planning of intensity modulated radiation therapy was practiced in 4MV, 6MV, 15MV X-ray energy in brain tumor. In these X-ray energy, was considered the dose distribution and dose volume histogram.

2. MATERIALS AND METHODS

The planning of intensity modulated radiation therapy was established Corvus treatment planning system (NOMOS, USA) and 21 EX linear accelerator(Varian, USA). Flow chart of IMRT planning in Corvus system was given Fig. 1. Gantry angle of treatment planning are 20, 60, 100, 140, 180, 220, 260, 300, 340. Constraint of intensity modulated radiation therapy planning was given. Dose distribution and dose volume histogram of the planning of intensity modulated radiation therapy copared with 4MV, 6MV, 15MV X-ray energy in brain tumor.

3. RESULTS

In dose distribution of 4MV, 6MV, 15MV X-ray energy in brain tumor, mean dose of planning target volume was 18.91Gy, 20.35 Gy, 19.64 Gy. Irradiated dose in right optic nerve was 6.43 Gy, 6.70 Gy, 5.74 Gy. Difference according to energy showed 10.1% in 6MV, 8.4% in 15MV. Irradiated dose in right eye was 8.5 Gy, 8.95 Gy, 8.73 Gy. Difference according to energy showed 5.2% in 6MV, 2.7% in 15MV. Irradiated dose in optic chiasm was 11.26 Gy, 11.23 Gy, 11.84 Gy. Difference according to energy showed - 0.1% in 6MV, 5.2% in 15MV. Irradiated dose in brainstem was 14.70 Gy, 15.28 Gy, 14.95 Gy. Difference according to energy showed 3.9% in 6MV, 1.7% in 15MV (Fig. 2, 3. Table 1).

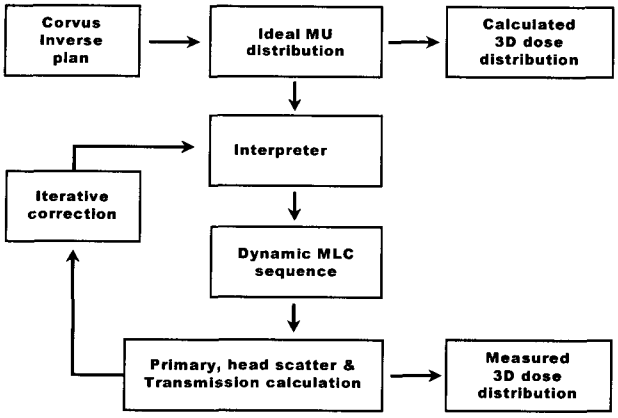

Fig. 1. Flow chart of IMRT plannig in Corvus system (Webb12).

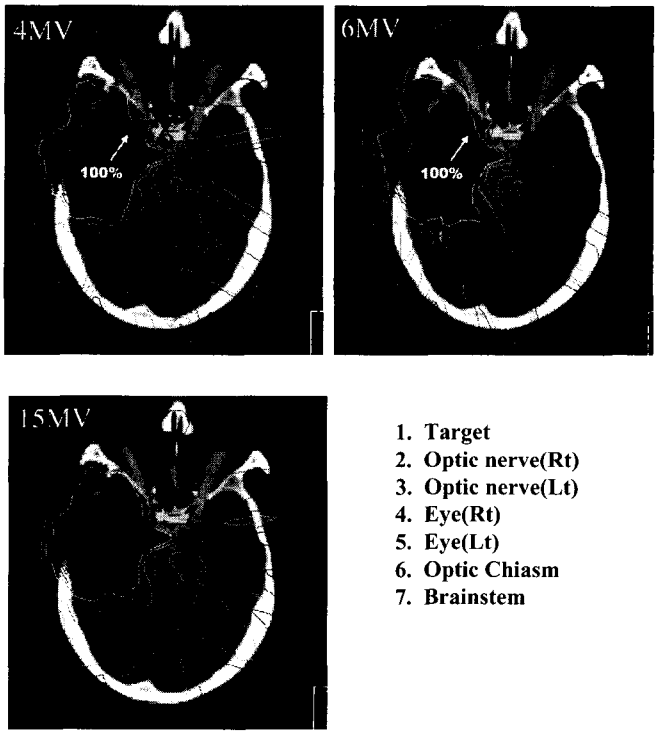

Fig. 2. Optimized dose distributions for each energy

4. DISCUSSION AND CONCLUSIONS

May 1996 saw the very first conference in Durango, Colorado, entirely devoted to the discussion of IMRT, which resulted in the edited by Sternick. The reasons are easy to identify.

1) Clinicians require concave dose distributions in maybe 30% of clinical cases. These cannot be achieved without IMRT and IMRT offers a significant stepfunction leap in tumour control probability without compromising normal structures.
2) Computer control of radiation delivery is possible.

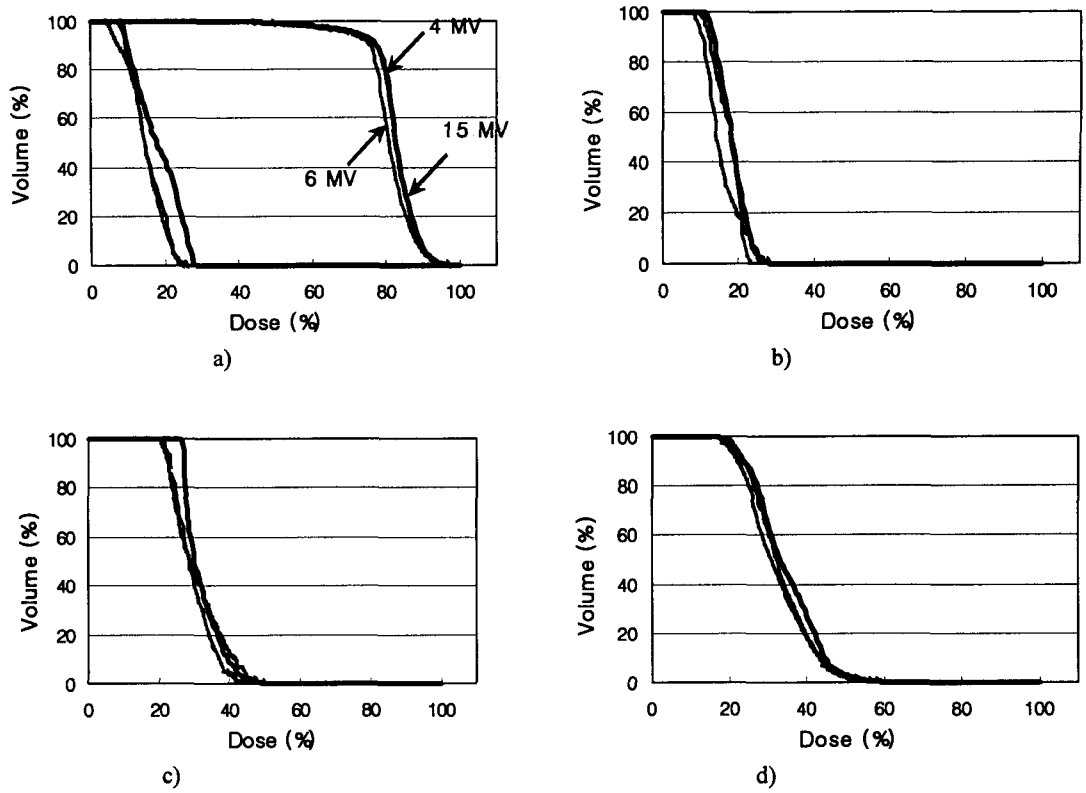

Fig. 3. Dose Volume Histogram for 4, 6, 15 MV a)PTV& Eye b) Optic nerve c) Optic chiasm d)Brainstem

3) Inverse planning of determine IMRT distributions has reached maturity and can be performed in realistic times.
4) 3D medical imaging by four modalities (CT, MRI, SPECT and PET) can more accurately determine the geometry of target and normal structures.
5) Techniques to verify and QA IMRT delivery are emerging.

As a results of these, in brain tumor, treatment planning of intensity modulated radiation therapy in 9 treatment field showed no relation with energy dependency.

	PTV	Optic-nerve(R)	Optic-nerve(L)	Eye(R)	Eye(L)	Optic-chiasm	Brainstem
volume(cc)	212.74	1.69	1.86	10.05	10.80	0.61	20.35
4MV							
MinDose(Gy)	8.27	4.82	2.41	2.76	1.61	5.97	3.79
MeanDose(Gy)	18.91	8.51	4.14	6.23	4.11	7.28	7.82
MaxDose(Gy)	22.97	11.14	6.43	8.50	6.55	11.26	14.70
SDDose(Gy)	1.52	1.21	0.86	1.31	1.40	1.15	1.89
6MV							
MinDose(Gy)	9.47	6.56	1.89	3.41	1.01	5.30	3.91
MeanDose(Gy)	20.35	9.38	3.83	6.63	3.70	7.35	8.01
MaxDoseGy)	25.25	12.27	7.70	10.35	6.44	11.23	15.28
SDDose(Gy)	1.74	1.12	1.16	1.53	1.27	1.33	2.05
15MV							
MinDose(Gy)	8.73	5.98	2.15	3.23	1.67	4.78	4.43
MeanDose(Gy)	19.64	8.63	4.08	5.51	3.58	7.22	7.87
MaxDoseGy)	23.92	12.08	5.74	8.73	5.98	11.84	14.95
SDDose(Gy)	1.52	1.14	0.86	1.14	0.95	1.73	1.84

Table 1. Total accumulated dose of tumor and critical organ in 4, 6, 15MV

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