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Fractionated Stereotactic Radiation Therapy for Intracranial Benign Tumor : Preliminary Results of Clinical Application

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Purpose : With the development of stereotactic immobilization systems capable of reliable serial repositioning, fractionated stereotactic radiation therapy (FSRT) offers the potential for an improved treatment outcome by excellent dose delivery, and dose distribution characteristics with the favorable radiobiological properties of fractionated irradiation. We describe our initial experience using FSRT for the treatment of intracranial benign tumor.

Materials and Methods : Between August 1995 and December 1996, 15 patients(7 males and 8 females aged 6-70 years) were treated with FSRT. The patients had the following diagnosis : pituitary adenoma(10) including one patient who previously had received radiotherapy, craniopharyngioma (2), acoustic neurinoma (1), meningioma (2). Using the Gill-Thomas-Cosman relocatable head frame and multiple non-coplanar therapy, the daily dose of 2Gy was irradiated at 90% to 100% isodose surface of the isocenter. The collimator sizes ranged from 26mm to 70mm.

Results : In all patients except one follow-up lost, disease was well- controlled. Acute complication was negligible and no patient experienced cranial nerve neuropathies and radiation necrosis. In overall patient setup with scalp measurements, reproducibility was found to have mean of 1.1 ± 0.6 mm from the baseline reading.

Conclusion : Relocatable stereotactic system for FSRT is highly reproducible and comfortable. Although the follow-up period was relatively short, FSRT is considered to be a safe and effective radiation technique as the treatment

of intracranial tumor. But the fractionation schedule(fraction size, overall treatment time and total dose) still remains to be solved by further clinical trials.

Key Words : Fractionated stereotactic radiation therapy, Relocatable head frame, Intracranial tumor

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1-3)

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3

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4-7)

가

3

가

3

11-13)

14)

3

(fractionated
FSRT)가

15-17)

FSRT

FSRT

1995 8 1996 12 15

가 FSRT

Gill-Thomas-Cosman((Radionics Inc., Burlington, MA, USA)

(dental plate)

(headrest)

가

(Fig. 1).

가 가

가

(Fig. 2).

(localizer)

(target volume)

(critical organ) 3

XKnife (Radionics Inc., Burlington, MA) 3 (multiple arc therapy)

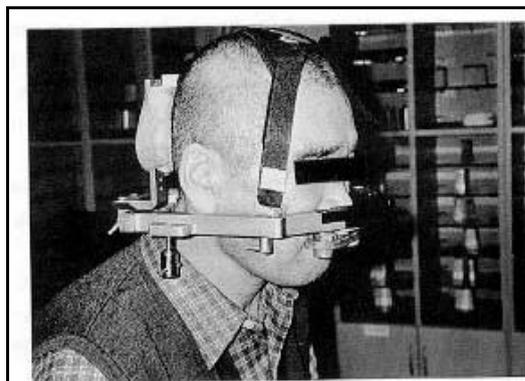


Fig. 1. Gill-Thomas-Cosman III frame in place on a patient which is composed of base ring and dental plate, headrest, head strap.

2-3mm



Fig. 2. Gill-Thomas-Cosman III frame modified for young children and poor cooperative or edentulous patients using thermoplastic mask.

=95%)
 4MV 가
 FSRT depth
 helmet
 12
 6-70 (=40)
 7 8
 1
 FSRT
 10 (1
), 2 , 1 , 2
 . 2.6-7.0cm(=4.2cm)
 , 1 2Gy 5
 , 44-60Gy (Table 1).
 가 (boost)

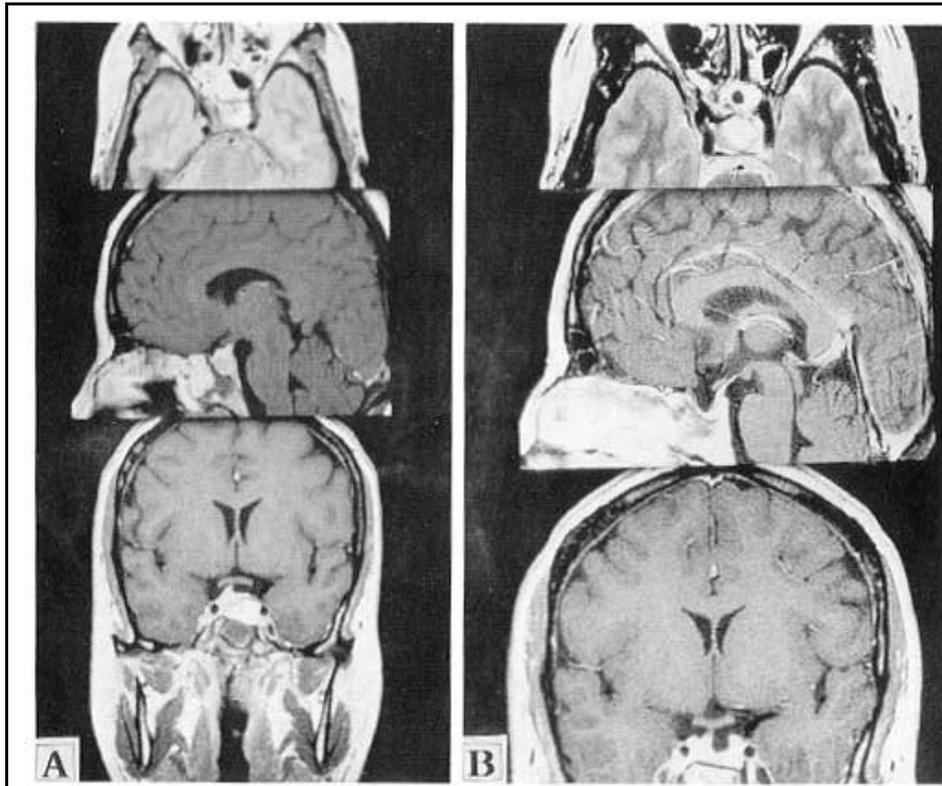


Fig. 3. Thirty-nine-year old woman with pituitary adenoma received 50Gy at the 95% isodose surface in 25 fractions using 26 mm collimator. (a) MRI scan pretreatment (b) MRI scan 12 months showing complete reduction.

Table 1. Clinical Data on 15 Patients with Intracranial Benign Tumor

No	Age	Sex	Diagnosis	Chief Complaint	Location	Type of Tumor Surgery	Tumor Size (cm)	Collimator Size (cm)	No. of Fr.	Total Dose (Gy)	Prescribed Isodose (%)	Tumor Dose (Gy)		F/U Comments		
												ESR	FSR			
1	39	F	adenoma	HA, galactorrhea oligomenorrhea	pituitary	TSA ¹	2.5×1.5	2.6	6	205	95	—	50/25	50	20 complete reduction	
2	41	M	adenoma	diplopia	pituitary	TSA	2.5×2.0	4.2	4	330	90	—	50/25	50	17 decreased size	
3	53	F	adenoma	VF ² defect	VA ³ 1, VF defect	pituitary	TSA	2.5×1.5	3.0	4	240	90	—	54/27	54	16 decreased size
4	29	M	adenoma	proboscemia	pituitary	TSA	4.5×3.0	5.5	4	165	100	—	56/28	56	14 decreased size	
5	44	F	recurrent adenoma	abnormally VF defect	pituitary	TSA	2.5×2.0	4.2	4	215	98	—	56/28	56	10 no change	
6	40	F	adenoma	VF defect	pituitary	TSA	2.5×2.5	4.9	6	225	97	—	55/28	55	10 decreased size	
7	40	M	adenoma	syncope	pituitary	TSA	4.0×3.0	5.5	4	200	97	—	45/23	45	10 loss of follow-up	
8	37	M	recurrent adenoma	HA	pituitary	TSA	3.5×3.5	5.5	5	145	95	—	44/22	44	9 complete reduction	
9	70	M	recurrent adenoma	VF defect	pituitary	—	3.0×1.5	3.8	5	150	95	—	50/25	50	6 no change	
10	40	F	recurrent adenoma	acromegaly	pituitary	—	3.0×1.5	3.4	5	210	9	—	50/25	50	6 no change	
11	6	M	craniopharyngioma	HA	suprasella	STR ⁴	1.5×1.5	3.25	5	205	95	36/18	14/7	50	12 calcification of residual	
12	33	M	recurrent craniopharyngioma	VF defect	suprasella	—	6.0×4.5	7.0	5	155	95	—	56/28	56	5 mass decreased size	
13	26	F	acoustic neuroma	LI hearing loss	LI CPA ⁵	STR	3.5×3.5	4.2	4	325	90	—	60/30	60	16 optimal low attenuation at CT	
14	67	F	meningioma	RL 6th n. palsy	chiasm	—	2.5×2.5	5.5	5	130	98	—	60/30	60	9 no change	
15	33	F	meningioma	facial hyposthesia	VA 1, VF defect	suprasella	STR	5.0×3.5	6.4	4	85	90	—	56/28	56	6 no change

¹transchiasmatic approach, ²visual field, ³visual acuity, ⁴subtotal resection, ⁵orientation-positive angle

1 FSRT 2 (Fig. 3)가
 , 4 , 3
 , 1
 2 1 , 1
 가 . 1
 (Fig. 4)
 2 가 3
 6-20 16 가
 6 1
 , 8
 (75%) 가
 44-56Gy 10



Fig. 4(a). MRI scan with contrast showing large acoustic neurinoma in 26-years old woman. She received 60Gy at the 90% isodose surface in 30 fractions using 42mm collimator.

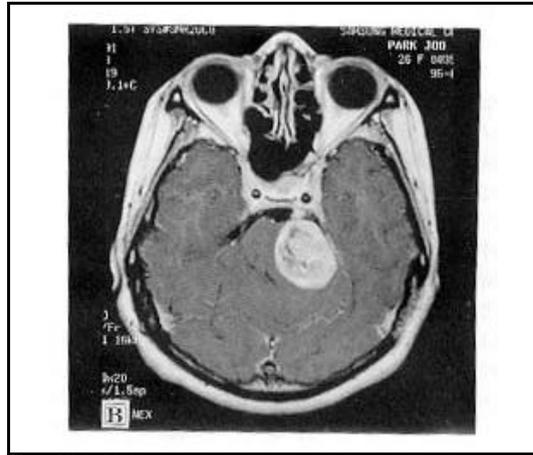


Fig. 4(b). MRI scan with contrast 5 months following FSRT using. The tumor is unchanged in size, but exhibits central necrosis.

Table 2. Fractionation Schedule of Fractionated Stereotactic Radiation Therapy

Institution	Histology	Fixation	Dose	× Fraction
McGill University ²⁵⁾	mixed	invasive	7Gy	× 6 Fx
Miami University ²⁶⁾	mixed	invasive	2-3Gy	× 12-31 Fx
Umea University ²⁷⁾	mixed	Laitinen	6Gy	× 2-5 Fx
Royal Marsden Hospital ²⁹⁾	recurrent glioma	GT II	5Gy	× 4-10 Fx
Royal Marsden Hospital ³⁰⁾	metastasis	GT II	5-10Gy	× 2 Fx
JCRT ³¹⁾	mixed	GTC III	1.8-2Gy	× 25-30 Fx
City Hospital ³⁵⁾	low grade glioma	invasive	10-25Gy	× 2 Fx
Purpan Hospital ³⁶⁾	mixed	Laitinen	2Gy	× 15-25 Fx
Temple University ³⁷⁾	CPA* tumor	GTC III	6Gy	× 6 Fx
Samsung Medical Center	mixed	GTC III	2Gy	× 22-30 Fx

*cerebellopontine angle

2-6 FSRT
 depth helmet
 12
 1.1 ± 0.6mm
 1950
 18)
 (arteriovenous malformation)
 4, 19)
 20, 21)
 14)
 FSRT가
 가
 24)
 가
 FSRT
 가
 Joint Center of Radiation Therapy(JCRT) 22)
 12 1 1.8Gy
 54Gy 100%
 가
 9
 25-52%
 5-67% 50%
 3%
 5, 11-13)
 Thomas Jefferson 23) 27
 80-92%
 2-8 Gy 54Gy 가 (equivalent 'boost therapy'
 dose in 1.8- 2.0Gy) 3
 가 1
 , 7
 5 6.3-7.5 Gy 2 6 37.8-45.5Gy
 2mm
 90%
 7-39 (20)
 가 12 5

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6-70 (40) 7 8
10 , 2 , 1 ,
2 . Gill-Thomas-Cosman 3
2Gy 90- 100% 26-70mm

: 6-20 1
7 , 1 ,
1 , 5

1.1 ± 0.6mm

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