

## 두개인두종에 대한 감마나이프 방사선수술\*

장종희 · 장진우 · 박용구 · 정상섭

= Abstract =

### Gamma Knife Radiosurgery for Craniopharyngioma

Jong Hee Chang, M.D., Jin Woo Chang, M.D.,  
Yong Gou Park, M.D., Sang Sup Chung, M.D.

Department of Neurosurgery, Brain Research Institute Yonsei University College of Medicine, Seoul, Korea

**Objective** : The purpose of this study are to evaluate the effectiveness of Gamma Knife radiosurgery(GKS) as a treatment of craniopharyngioma and to investigate the proper dose planning technique in GKS for craniopharyngioma.

**Method** : Between May 1992 and March 1999, seven Gamma Knife radiosurgical procedures were done for residual tumor mass of 6 patients with craniopharyngioma after microsurgical resection. Conventional radiation therapy was not performed. In this study, their clinical, radiological and radiosurgical data were analyzed and the radiation dosage to the optic pathway, hypothalamus, pituitary stalk, and cavernous sinus were calculated and correlation with clinical outcome was evaluated. The mean follow - up period was 33.5 months(12.3 - 55.2 months).

**Result** : The mean tumor volume was 4.4cc(0.4 - 18.0cc) and the maximum radiation dose ranged from 14 to 32 Gy(mean 20.9Gy). The radiation was given with isodose curve, 50 - 90% and the marginal dose varied within 8 - 22.4Gy(mean 12.7Gy). The mean number of isocenter was 4.3(1 - 12). The tumor was well controlled in all cases. In 5 of 7 cases, the size of tumor decreased to 10 - 50% of pre - GKS volume and remaining two showed no volume change. The mean dose to optic pathway was 5.7Gy(5.1 - 11.2Gy) and there were no complications.

**Conclusion** : GKS seems to be effective for control of craniopharyngioma as an adjuvant treatment after microsurgical resection and even suboptimal dose for tumor margin is considered to be enough for tumor control. It is safe with careful dose planning to protect surrounding important structures, especially optic pathway. We believe conventional radiation therapy should be avoided because it has limitation for dose planning of additional treatments such as radiosurgery or intracystic instillation of radioisotope in case of recurrence.

**KEY WORDS** : Radiosurgery · Gamma knife · Craniopharyngioma · Optic pathway · Dose planning · Suboptimal dose.

### 서론

(craniopharyngioma)

(radical resection),

(conventional radiation therapy

after subtotal resection), intracavitary radiation

가

가

60%

(cystic component)

가

2000

symposium

(dose planning)

## 대상 및 방법

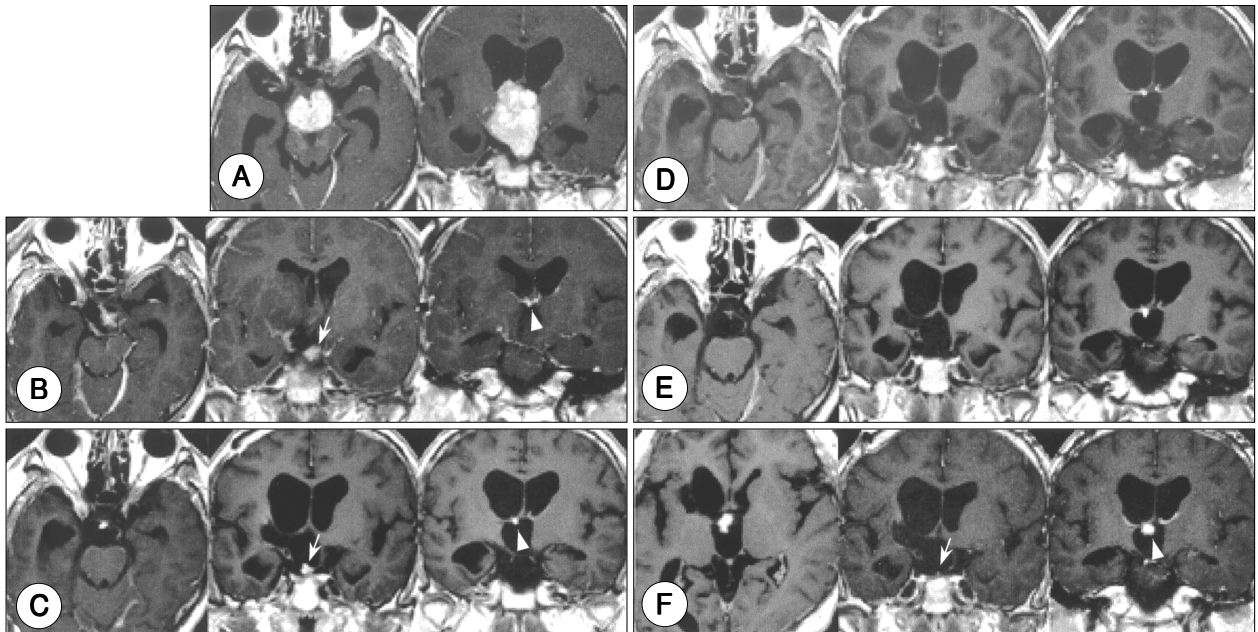
1988 9 2000 6 10 Sweden)  
 11 (radiosurgery)  
 1992 5 3 Sweden)  
 가 (linear accelerator)  
 1  
 30 가 (axial) 가 (coronal) 가 (optic nerve),  
 (foramen of Monro) 가 (optic chiasm), (optic tract)  
 (Fig. 1).

가 80%  
 80% 120% (static)  
 (radiologic control)  
 GammaPlan(version 5.30, Elekta,  
 KULA (version 5.4, Elekta,  
 (pituitarystalk), (hypothalamus),  
 (cavernous sinus)  
 MRI  
 50%

1 6 7  
 29.8 (4.4~62.9 ) 1 :  
 1 7  
 12.6 (13 ~29.9  
 )  
 33.5 (12.3~55.2 ) MRI 50~90% 12.  
 7Gy(8~22.4Gy) . Isocen-

## 결과

4.4cc(0.4~18.0cc)  
 20.9Gy(14~32Gy)  
 50~90% 12.  
 7Gy(8~22.4Gy) . Isocen-



**Fig. 1.** A : Preoperative MR images showing suprasellar craniopharyngioma. B : Postoperative and pre-radiosurgical MR images showing residual tumor at base (arrow) and equivocal remnant near foramen of Monro (arrowhead). GKS was done for only residual tumor at base. C - E : Serial follow-up MR images (4, 8, and 13 months after GKS, respectively) showing gradually decreased tumor at base (arrow) and enlarged remnant near foramen of Monro (arrowhead). F : Follow-up MR images at 30 months after GKS showing no visible tumor mass at base (arrow). The second GKS was done for the growing lesion of foramen of Monro (arrowhead).

ter 4.3(1~12) . 7 5  
 10~50% , 2 가  
 (radiologic control rate) 100%

**고 찰**

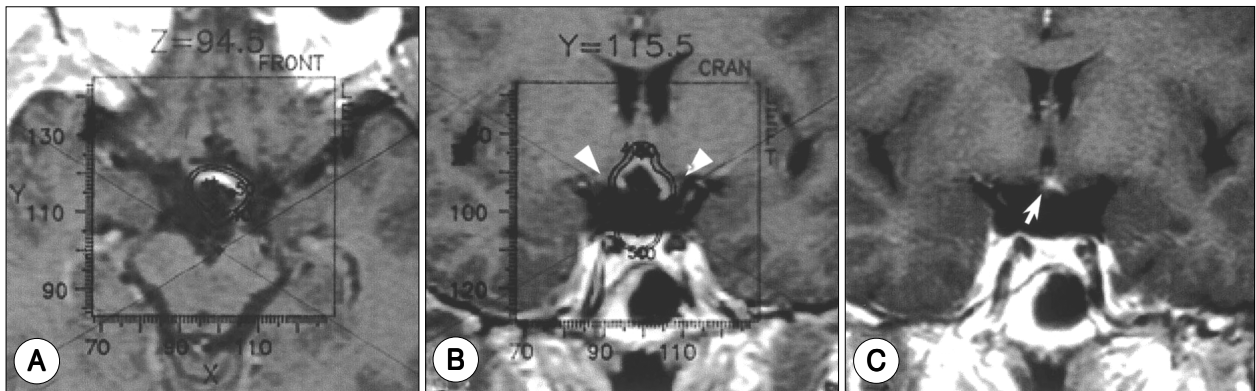
(Table 1).  
 5.72Gy(5.1~11.2Gy)가  
 8Gy 2  
 10.2Gy 11.2Gy가 30~97%  
 4.9Gy(0~10Gy), 5.2Gy(0~10.2Gy), 20~53%  
 4.9Gy(0~12Gy)가 7)9)12)16)18)24) 10~50%  
 , 40% 20%  
 가 8)19)  
 50~80% disease - free  
 survival ,  
 8~8.5Gy (suboptimal dose) 가 2)3)6)12)17)21)23),  
 , 3~5  
 (Table 1, Fig. 2).

**Table 1.** Volume change and radiosurgical dose of craniopharyngioma(n=7)

Case No.	Initial volume (cc)*	Last volume (%)**	Maximum dose (Gy)	Margin Dose (Gy)	Follow-up duration (months)
1	3.2	10	16	8***	39.9
2	2.4	10	17	8.5***	53.6
3	0.4	100	20	14	12.3
4	18.0	50	17	8.5***	55.2
5	0.7	100	30	15	13.0
6	2.8	10	14	12.6	44.9
7	3.0	50	32	22.4	15.5

\* : pre-radiosurgical volume of tumor  
 \*\* : percentage of tumor volume at last follow-up MRI per initial volume  
 \*\*\* : suboptimal dose

가 (fractionation) 1.8~2.5Gy/  
 day 45~70Gy 9~30%  
 23% , 12.5%  
 10)17)  
 (cystic tumor) intracavitary ra-  
 diation 가 80% 4)13)15)22)  
 Holmium - 166 chitosan  
 가 , Holmium - 166  
 90% 가 2.1mm



**Fig. 2.** A : Axial MR image for dose planning showing small residual portion of craniopharyngioma near hypothalamus. B : Coronal MR image for dose planning showing the mass contacted with bilateral optic tracts(arrowhead). The marginal dose for tumor was 8.5Gy and the dose to optic tracts was 5.1Gy. C : Follow-up MR image(14 months after GKS) showing shrunk tumor(arrow).

가

11)

Holmium - 166 chitosan

1972 Backlund가

가

9)16)20)

1)2)9)10)13)16)20)21)

가 collimator

large heavy shot

small

light shot 가 (steep gradient)

(isodose curve) intentional hot spot

2)4)5)10)16)

MRI

가

GammaPlan

5mm

10)13)20)

가 8~10Gy

2)9)10)13)20)

(marginal

dose) 9~18Gy

2)9)20)

. 7 5 (71.4%)

가

가

12~13

(volume response)

12.7Gy

10Gy 가 3 (8Gy ; 8.5Gy ; 8.5Gy)

10~50%

가

(minimal effective tumor margin dose)

가

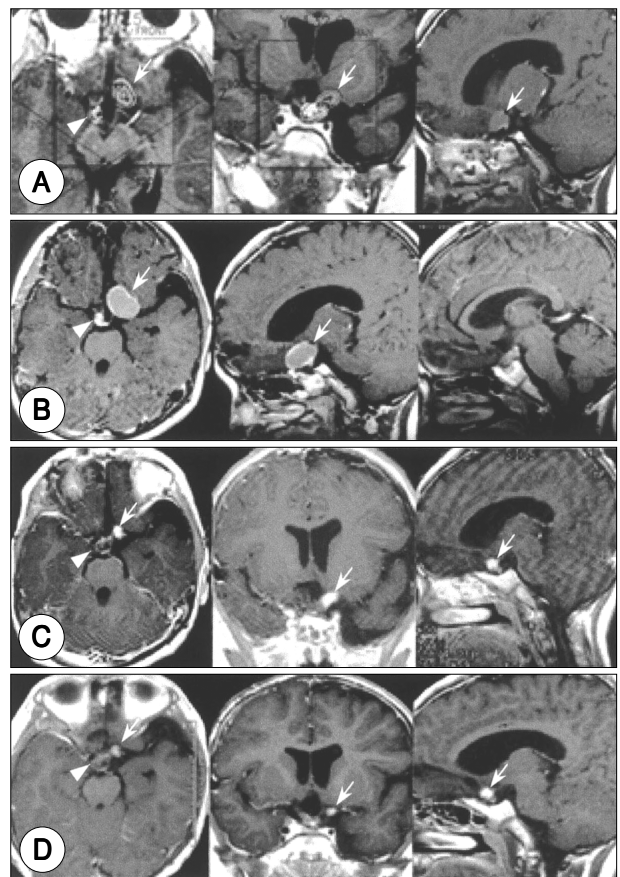
가 2.5~3cm

intracystic instillation

of radioisotope

가

intracy-



**Fig. 3.** A : MR images for dose planning showing residual portions of craniopharyngioma, cystic portion (arrow) and solid portion (arrowhead). B : Follow-up MR images (6 months after GKS) showing enlarged cystic portion (arrow) and shrunken solid portion (arrowhead). C - D : Follow-up MR images (17 and 33 months after GKS, respectively) showing shrunken and stable tumor, both cystic (arrow) and solid (arrowhead) portions.

stic instillation of radioisotope

(multicystic)

intracystic instillation of radioisotope

(solid)

ticystic component가

, 1

18

6

MRI ,  
MRI

17

. 33

MRI

(Fig. 3).

1)2)9)10)13)16)20)

10)

tracavitary radiation

3cm

### 결 론

가

가

가

mul-

가

2)

- : 2000 8 31
- : 2001 4 16
- :

120 - 752

134

: 02) 361 - 5625,

: 02) 393 - 9979

E - mail : ygpark@yumc.yonsei.ac.kr

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