

터어키안 주변종양에 대한 감마나이프 방사선 수술*

장종희 · 장진우 · 박용구 · 정상섭

= Abstract =

Gamma Knife Radiosurgery for Juxtaseilar Tumors

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 : Around the sellar area, there are many important structures. But, the optimal radiation dosage for minimal toxicity to surrounding neural tissue has not been firmly established. The purpose of this study is to evaluate the radiosurgical outcome of juxtaseilar tumors and to investigate the relationship between radiation dosage and toxicity to neural tissue.

Method : Between May 1992 and June 2000, we treated 65 juxtaseilar tumors by using the Leksell Gamma Knife. Among them, 52 patients who could be followed more than 1 year were included in this study. The radiosurgical dosage to the optic pathway, cavernous sinus, Meckel's cave, hypothalamus, pituitary gland and stalk, and brain stem was analyzed and correlated with clinical outcome. The mean follow-up period was 33.5 months (range 12.2 - 99.0 months).

Result : The clinical response rate was 69.2%. The volume response rate was 61.0% and the radiologic control rate was 92.7%. There were 4 complications (7.7%) of 2 trigeminal neuropathy, 1 abducens nerve palsy, and 1 trigeminal and transient abducens nerve palsy. The optic apparatus appeared to tolerate doses greater than 10Gy. The risk of cranial nerve complications in cavernous sinus seemed to be related to doses of more than 16Gy. In 3 of 4 patients who received more than 16Gy to cavernous sinus, the abducens or trigeminal neuropathy occurred. Also, one patient who received more than 15Gy to the Meckel's cave, trigeminal neuropathy developed. The hypothalamus, pituitary gland and stalk, and brain stem were relatively tolerable to radiation.

Conclusion : Gamma Knife radiosurgery seems to be an effective method to control the growth of juxtaseilar tumors. To avoid injury to surrounding important neural tissue, careful dose planning and further study for radiation toxicity to neural tissue were needed.

KEY WORDS : Radiosurgery · Gamma Knife · Juxtaseilar · Optic nerve · Cranial nerve.

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대상 및 방법

1992년 5월 2000년 6월 사이에 65명의 환자를 대상으로 하였다. 이 중 52명은 수술을 받았고, 13명은 추적 관찰을 받았다. 환자의 연령은 9세에서 12세까지였으며, 평균 연령은 11.5세(표준편차 1.2)였다. 성별 분포는 남자 33.5명(52.0%), 여자 18.5명(28.6%)이었다. 병변의 위치는 시상상 17명(26.2%), 시상하부 3명(4.6%), Meckel's cave 3명(4.6%), clivus 2명(3.1%), 시상하부 이외의 다른 부위 12명(18.5%)이었다. 조직학적 분류는 24명(36.9%)의 meningioma, 6명(9.2%)의 craniopharyngioma, 5명(7.7%)의 schwannoma, 4명(6.2%)의 metastasis, 1명(1.5%)의 head & neck Ca., 3명(4.6%)의 hamartoma, 2명(3.1%)의 chordoma, 0명(0%)의 neurocytoma, 0명(0%)의 anaplastic astrocytoma이었다. 방사선 치료는 25명(38.5%)의 환자에게 시행되었으며, 27명(41.5%)의 환자에게는 수술 후 보조 방사선 치료를 시행하였다. 방사선 치료의 반응은 10.9cc(0.09-36.7cc)의 체적 감소가 관찰되었다. 방사선 치료 후 80%의 환자가 volume response, 80%의 환자가 static response, 120%의 환자가 enlarged response, 120%의 환자가 radiologic control, 120%의 환자가 clinical response를 보였다. MRI는 axial, coronal, sagittal plane로 촬영되었으며, 50%의 환자에게는 KULA, Meckel's cave, clivus를 포함한 부위를 촬영하였다. 수술은 52명(78.8%)의 환자에게 시행되었으며, 12명(23.1%)의 환자에게는 추적 관찰을 받았다. 수술 후 50%의 환자가 volume response, 50%의 환자가 static response, 50%의 환자가 enlarged response, 50%의 환자가 radiologic control, 50%의 환자가 clinical response를 보였다. 추적 관찰을 받은 13명(17.3%)의 환자 중 9명(69.2%)은 volume response, 9명(69.2%)은 static response, 9명(69.2%)은 enlarged response, 9명(69.2%)은 radiologic control, 9명(69.2%)은 clinical response를 보였다.

결 과

1. 연령분포, 성별 및 임상증상

환자의 연령은 9세에서 12세까지였으며, 평균 연령은 11.5세(표준편차 1.2)였다. 성별 분포는 남자 33.5명(52.0%), 여자 18.5명(28.6%)이었다. 병변의 위치는 시상상 17명(26.2%), 시상하부 3명(4.6%), Meckel's cave 3명(4.6%), clivus 2명(3.1%), 시상하부 이외의 다른 부위 12명(18.5%)이었다. 조직학적 분류는 24명(36.9%)의 meningioma, 6명(9.2%)의 craniopharyngioma, 5명(7.7%)의 schwannoma, 4명(6.2%)의 metastasis, 1명(1.5%)의 head & neck Ca., 3명(4.6%)의 hamartoma, 2명(3.1%)의 chordoma, 0명(0%)의 neurocytoma, 0명(0%)의 anaplastic astrocytoma이었다. 방사선 치료는 25명(38.5%)의 환자에게 시행되었으며, 27명(41.5%)의 환자에게는 수술 후 보조 방사선 치료를 시행하였다. 방사선 치료의 반응은 10.9cc(0.09-36.7cc)의 체적 감소가 관찰되었다. 방사선 치료 후 80%의 환자가 volume response, 80%의 환자가 static response, 120%의 환자가 enlarged response, 120%의 환자가 radiologic control, 120%의 환자가 clinical response를 보였다. MRI는 axial, coronal, sagittal plane로 촬영되었으며, 50%의 환자에게는 KULA, Meckel's cave, clivus를 포함한 부위를 촬영하였다. 수술은 52명(78.8%)의 환자에게 시행되었으며, 12명(23.1%)의 환자에게는 추적 관찰을 받았다. 수술 후 50%의 환자가 volume response, 50%의 환자가 static response, 50%의 환자가 enlarged response, 50%의 환자가 radiologic control, 50%의 환자가 clinical response를 보였다. 추적 관찰을 받은 13명(17.3%)의 환자 중 9명(69.2%)은 volume response, 9명(69.2%)은 static response, 9명(69.2%)은 enlarged response, 9명(69.2%)은 radiologic control, 9명(69.2%)은 clinical response를 보였다.

(32.7%)

2. 종양의 위치

시상상 17명(26.2%), 시상하부 3명(4.6%), Meckel's cave 3명(4.6%), clivus 2명(3.1%), 시상하부 이외의 다른 부위 12명(18.5%)이었다. (Table 1).

3. 조직학적 분류

24명(36.9%)의 meningioma, 6명(9.2%)의 craniopharyngioma, 5명(7.7%)의 schwannoma, 4명(6.2%)의 metastasis, 1명(1.5%)의 head & neck Ca., 3명(4.6%)의 hamartoma, 2명(3.1%)의 chordoma, 0명(0%)의 neurocytoma, 0명(0%)의 anaplastic astrocytoma이었다. (Table 2).

4. 선량계획

10.9cc(0.09-36.7cc)의 체적 감소가 관찰되었다.

Table 1. Location of juxtaseilar tumors(n = 52)

Location	No. of cases(%)
Parasellar	33(63.5%)
Cavernous sinus	30(57.7%)
Meckel's cave	3
Suprasellar	17(32.7%)
Hypothalamus	8(15.4%)
Pituitary stalk	3
Anterior clinoid process	3
3rd ventricle	2
Planum sphenoidale	1
Retrosellar	2(3.8%)
Clivus	2

Table 2. Pathological classification and treatment modality

Pathology	Treatment modality		Total
	Primary Tx.*	Adjuvant Tx.**	
Meningioma	10	14	24(46.2%)
Craniopharyngioma	0	6	6(11.5%)
Schwannoma	5	0	5(9.6%)
Metastasis	4	1	5(9.6%)
Head & neck Ca.	1	4	5(9.6%)
Hamartoma	3	0	3(5.8%)
Chordoma	2	0	2(3.8%)
Neurocytoma	0	1	1(1.9%)
Anaplastic astrocytoma	0	1	1(1.9%)
Total	25(48.1%)	27(51.9%)	52(100%)

* : radiosurgery as a primary treatment

** : radiosurgery as an adjuvant treatment after operation

27.1Gy(10.0 34.0Gy) .
 40 90%
 13.7Gy(5 17.5Gy) . 40
 26.7Gy, 13.6
 Gy, 12 25.4Gy, 12.5Gy ,
 1 60Gy, 30
 Gy

5. 임상적 반응

가 21 ,
 가 15
 (clinical response rate) 69.2% (Fig. 1).
 13 65
 가 12 , 4
 1 (Table 3).

6. 방사선학적 반응

MRI CT 가 41 ,
 25 가
 (volume response rate) 61.0% .

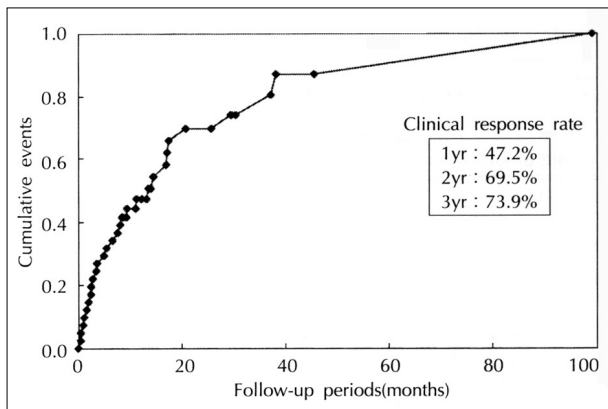


Fig. 1. Cumulative events curve by Kaplan-Meier survival analysis for clinical response of patients with juxtaseellar tumor since Gamma Knife radiosurgery.

Table 3. Clinical response of juxtaseellar tumors after Gamma Knife radiosurgery

Clinical results	No. of cases(%)
Improved**	21 (40.4%)
No new symptom*	15 (28.8%)
Sustained	12 (23.1%)
Aggravated	4 (7.7%)
Total	52 (100%)

* : no newly developed symptom in asymptomatic patients
 ** : clinical response, 36/52 patients(69.2%)

가 13 , 가 가 가 3 (Table 4),
 (radiologic control rate) 92.7% (Fig. 2, 3).

7. 치료 실패

가 가 가 3
 (clivus chordoma)
 8.4
 (sarcomatous change)
 가 (cystic adenocar-
 cinoma)

9.2 2

(nasopharyngeal carcinoma)

8. 합병증

52 4 (7.7%)
 가 , 1
 가

Table 4. Radiologic response of juxtaseellar tumors after Gamma Knife radiosurgery

Volume change	No. of cases(%)
Shrunken (<80%)*	25 (61.0%)
Static (80 - 120%)**	13 (31.7%)
Enlarged (>120%)	3 (7.3%)
Total	41 (100%***)

* : volume response
 * , ** : radiologic control, 38/41 patients(92.7%)
 *** : MRI follow-up in 41 patients(78.8%)

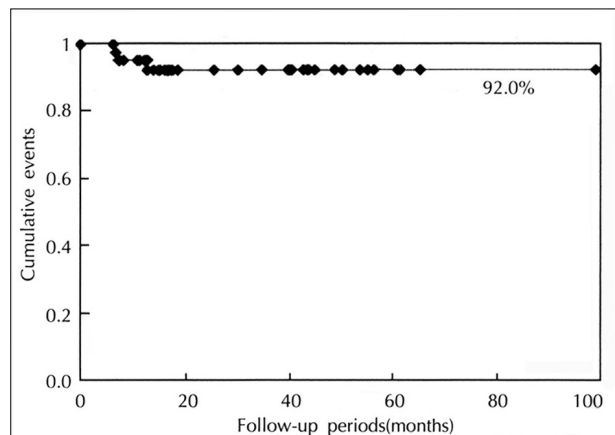


Fig. 2. Cumulative events curve by Kaplan-Meier survival analysis for radiologic control of patients with juxtaseellar tumor since Gamma Knife radiosurgery.

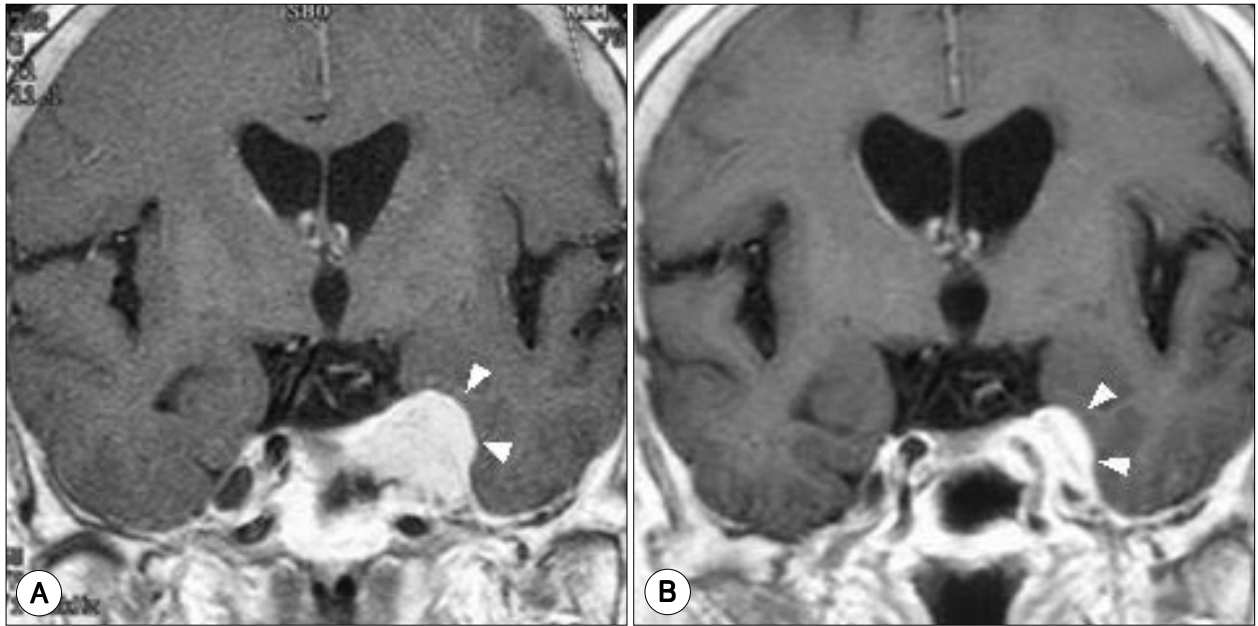


Fig. 3. A : Pre-radiosurgical MRI showing left cavernous sinus and Meckel's cave meningioma. B : Follow-up MRI(14 months after Gamma Knife radiosurgery) showing sh-rinked tumor.

가 2
1
9. 시신경계의 방사선 조사량

5 47
. 8Gy 가 가 40 , 8
10Gy가 가 5 10Gy 가
2
13Gy 14Gy가 (Table
5). , 10Gy 14.

9 40.5
10. 해면정맥동의 방사선 조사량

, 16Gy 가 48
. 16Gy 16.2Gy
17.4 , 16.5Gy
6 가 . 18Gy
18.5Gy가 2
가 (Table 6).

11. Meckel's cave의 방사선 조사량

Meckel's cave 1 15Gy 가
, . 1

Table 5. Radiation dose to optic pathway(n = 47)*

Dose range(Gy)	No. of cases
<8	40
8 - 10	5
10 - 12	0
12 - 14	2

* : no visual complication

Table 6. Radiation dose to cavernous sinus(n = 52)

Dose (Gy)*	No. of cases	Complications
<15	46	none
16.0	2	none
16.2	1	none
16.5	1	V **
18.0	1	VI ***
18.5	1	VI (transient), V

* : radiation dose to the lateral wall of cavernous sinus

** : decreased facial sensation

*** : limitation on lateral gaze

Meckel's cave 17.5Gy가
, 가 6
, 14

12. 기타 주요구조물의 방사선 조사량

, , 13Gy,
21.15Gy, 14.25Gy가

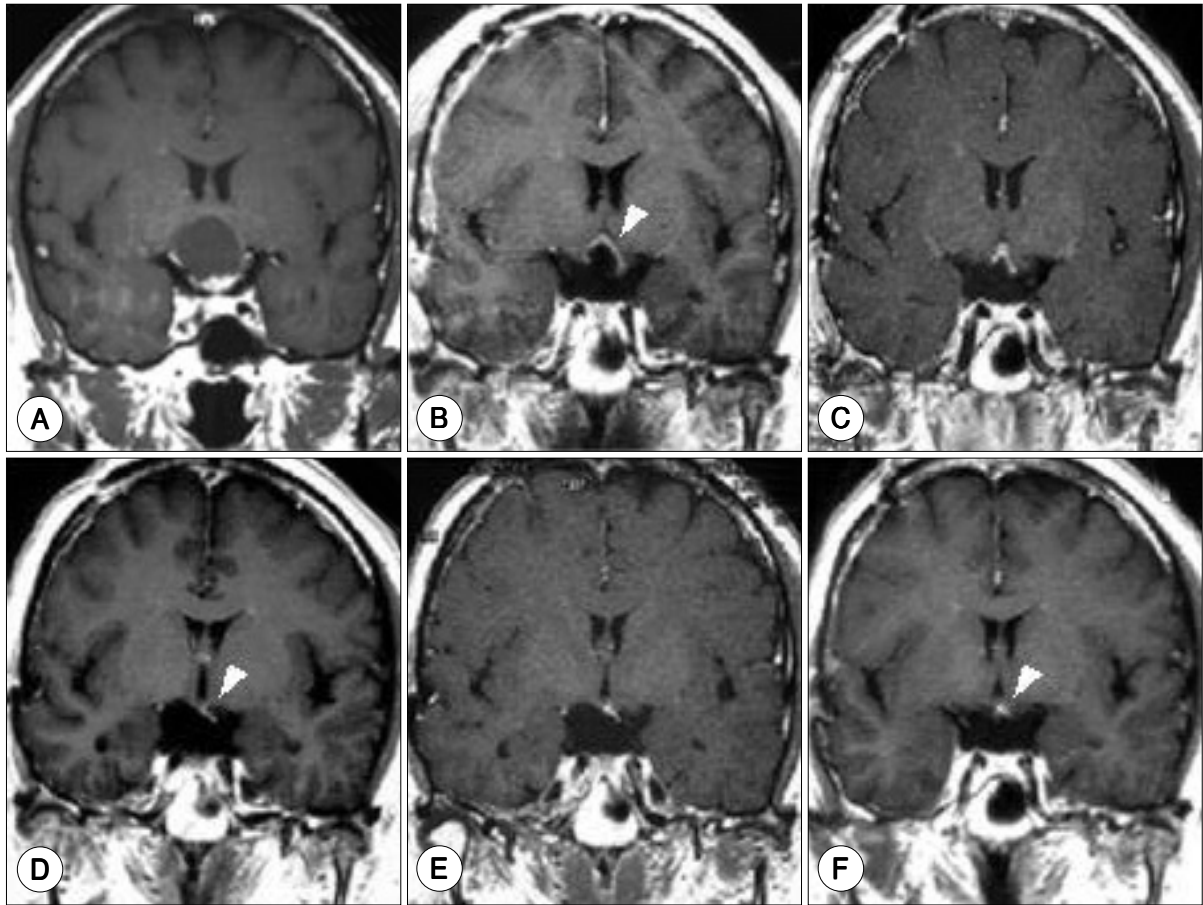


Fig. 4. A : Preoperative MRI showing suprasellar craniopharyngioma. B : Postoperative and pre-radiosurgical MRI showing residual tumor near hypothalamus and optic pathway. C-F : Serial follow-up MRI (4, 13, 24, and 35 months after Gamma Knife radiosurgery, respectively) showing gradually decreased tumor remnant.

kel's cave,

13. 종양에 적정량이하의 방사선이 조사된 경우

12Gy 가 가 9 5
 MRI 5Gy 9.5Gy가
 12 35
 가 , 8 8.5Gy가 가
 3 가 가 가
 (Fig. 4).

고 찰

가 가 10Gy

Mec -

가 (Schwann's cell)
 가 10)
 10Gy 2)11), 8
 가 가
 3)6)8-10)13)14) . Leber 7)8)
 50
 10Gy , 10 15Gy,

15Gy 가 0%, 26.7%, 77.8% 가 10Gy 가 16Gy . Meckel's cave 15Gy , Me-

가 , Morita ¹¹⁾ 가 8Gy 가 Meckel's cave 17.5Gy가 1 , dose) 88 59 8Gy (16Gy) 12 16Gy가 (9 12mm 21Gy, 13Gy, 14Gy 가 가 10Gy . 2 52 14Gy가 1 13Gy, 1 41 , 가 38 (92.7%) 52 14.9 40.5 , 2 36 (69.2%) , 69.2% 가 10Gy 가 (27/39) , 39 50% ¹⁾, 30Gy 5 3, 4, 5, 6 가 가 ⁷⁾. Tishler ¹⁴⁾ 12Gy ⁴⁾. 가 가 9 5 MRI 3 8 8.5Gy 가 3, 4, 6 4.5 30Gy가 , 5 5 . Leber ⁷⁾ 가 가 20Gy가 , Morita ¹¹⁾ Meckel's cave 19Gy ²⁾⁶⁾¹²⁾. 5Gy가 1 9.5Gy가 가 가 16Gy 가 48 . Iwai ⁵⁾ 24 . 16Gy 16.2Gy 17.4 , 8 15Gy (median, 10.6Gy) 16.5Gy, 18Gy, 18.5Gy가 3

가

결 론

dose plan
가

- : 2000 8 16
 - : 2000 10 12
 - :
120 - 752 134
- : 02) 361 - 5625, : 02) 393 - 9979
E - mail : ygpark@yumc.yonsei.ac.kr

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