

운동성 장애에 대한 감마나이프 시술의 초기경험*

홍준기 · 김무성 · 이선일 · 정용태 · 김수천 · 심재홍

= Abstract =

Preliminary Report of Gamma Knife Radiosurgery for the Movement Disorders

Joon Ki Hong, M.D., Moo Seong Kim, M.D., Sun Il Lee, M.D.,
Yong Tae Jung, M.D., Soo Chun Kim, M.D., Jae Hong Sim, M.D.

Departments of Neurosurgery, College of Medicine, Inje University, Paik Hospital, Pusan, Korea

Objectives : With recent improvements in neuroimaging and the development of third and fourth-generation radiosurgical dose-planning soft ware, came a renewed interest in using radiosurgery for the treatment of movement disorders. Radiosurgery involves no opening of the cranium and no incisions, eliminating both the risk of hemorrhage from passing an electrode to the depths of meningitis from operative infection. It is for these reasons stereotactic radiosurgical treatment of movement disorders has value in a small subgroup of patients. The authors report four cases of Parkinson's disease and one case of dystonia that were treated by Gamma knife.

Methods : Radiosurgical nucleus ventralis intermedius thalamotomy using the gamma knife unit was performed to make lesion in two Parkinson's disease patients. A radiation dose of 120Gy was delivered to nucleus using a single 4 - mm collimator plug pattern following classic anatomical landmarks. Patients were followed for a median of 10.5 months(range 9 - 12 months). An independent neurological evaluation of tremor, based on the change in the United Parkinson's Disease Rating Scale tremor score(UPDRS), was correlated with a subjective evaluation. Gamma knife ventrolateral(V.O.P) thalamotomy was performed in one case of dystonia. A central dose of 150Gy was delivered and the patient was followed for 18 months. Gamma knife globus pallidus interna pallidotomy was performed in two Parkinson's disease patients. A radiation dose of 130Gy(range 120 - 140Gy) was delivered. Patients were followed for a median of 13 months(range 9 - 14 months).

Result : Ventrolateral thalamotomy in dystonia produced regained left hand usage in order to be able to use the telephone. Ventralis intermedius thalamotomy produced an excellent improvement of the tremor in one case, mild improvement of the tremor in the other case of Parkinson's disease. A globus pallidus internalis(GPi) pallidotomy produced improvement of rigidity and dyskinesia : one other showed no change. There were no neurological complications.

Conclusion : Gamma Knife thalamotomy considered a safe and effective technique for the treatment of tremor in Parkinson's disease. Although the results from Longer follow - up is not available yet, the short - term results seem to be encouraging.

KEY WORDS : Gamma knife radiosurgery · Thalamotomy · Pallidotomy · Tremor · Rigidity · Dyskinesia.

서 론

1999 2 6

가

Table 1. Case summary

Case	Age(years)	Diagnosis	Side	Central dose Gy	Shot	Radiation time, min	Outcome
Case 1	F/16	Dystonia	Right	150	1	125.22	Good improvement
Case 2	F/54	P.A.	Left	120	1	72.68	Good improvement
Case 3	F/41	P.A.	Right	140	1	92.2	Mild improvement
Case 4	M/77	P.A.	Left	120	1	158.02	Excellent improvement
Case 5	F/62	P.A.	Right	120	1	157	Good improvement

*PA : Parkinson's disease

Table 2. Correlation of independent neurologist evaluations and patient self-assessment scores

UPDRS Score as reported by independent neurologists	Subjective improvement/ as reported by the patients
0	None
1	Mild (- 33% relief)
2	Good (34 - 66%)
3	Excellent (67 - 99%)
3 or 4	Absent tremor

(probes)가

연구 결과

1. 임상적 분석

1991 1, 4, 16
 1994 77, 50, 1
 1998 12, 2
 616
 5 1
 120 150Gy가
 (Table 1).

2. 시상파괴술 및 담창구절단술시 표적물

11.5mm, 3mm
 6mm, 15mm, 4mm
 2 3mm, 20 22mm, 6 8mm
 1mm
 (axial plain)

3. 치료결과

1, 3, 6 가
 6
 1
 5, 24 가 가

연구대상 및 방법

1994 10 1998 12
 Cobalt - 60(Elekta) Gamma knife
 Leksell
 1mm
 4
 2
 2
 1
 3
 5

2 1 12 , 11 41 (commissures)
 2 1 UPDRS
 0 , 1
 12 4 Table 3 8), -
 , 9 1 1 3 ,
 , 15)
 고 찰 가 5)9).
 (localization)가 , Dogali
 1968 Leksell¹²⁾ Young 3)17)
 , 1990
 ± 1mm
 가 가

Table 3. Stereotactic target landmarks

Procedure	Clinical indication	Target	Landmark	AP	Coordinates	Depth				
Basal thalamotomy	Pain	Extralemniscular fibers	Post. comm.	A1	12	0 to + 11				
				A4	11	+ 2 to + 13				
Medial thalamotomy	Pain	Intralaminar-CM nu.	Post. comm.	A9	9	+ 2 to + 13				
Dorsomedian thalamotomy	Pain Affective disorders	Dorsomedial nu.	Post. comm.	A4	4	+ 2 to + 10				
VL thalamotomy	Tremor Dystonia	VL(V.o.p) nu.	Mid AC-PC	P2	11.5	+ 3				
VL thalamotomy	Rigidity	VL(V.o.p) nu.	Mid AC-PC	A2	9.5	+ 3				
V.i.m thalamotomy	Tremor	V.i.m. nu.	Post. comm.	A5	15	0				
Campotomy	Tremor Rigidity Dystonia Cerebral palsy Seizures	Forel's field	Mid AC-PC	0	6	- 2				
				Pallidotomy	Hemiballism Cerebral palsy Salaam convulsions	Globus pallidus	Ant. comm.	P2	10	0
				Cingulotomy	Pain Obsessive compulsion Anxiety Depression	Cingulum	Ant. horn	P30	Lat. edge	+ 5
								P30	8 medial to lateral edge	+ 5
P18	Lateral edge	+ 5								
P18	8 medial to lateral edge									
Anterior capsulotomy	Obsessive compulsion	Ant. limb of int. capsule	Ant. clinoid	A15	6	+ 10				
				A15	6	+ 15				
				A15	14	+ 10				
Amygdalotomy	Temporal lobe seizure	Amygdala	Tip of temporal horn	A5	5 medial to lateral edge	3 above inferior border				

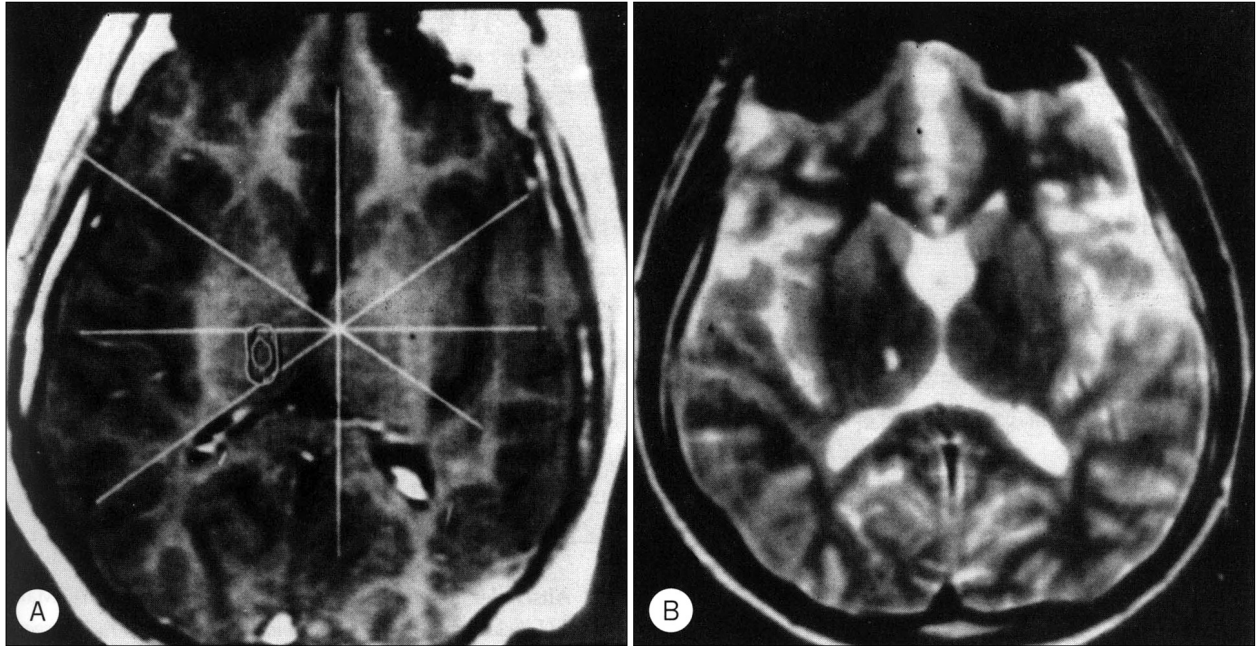


Fig. 1. A : MR image demonstrating the planned thalamic target in dystonia. B : Postoperative MR image demonstrating the thalamotomy lesion.

6mm, 15mm, 4mm
 4mm 50%
 4mm 130Gy,
 150Gy
 . 60% (isodose) plugs
 , 10 20%
 가 .
 180 200Gy
¹²⁾, Young ¹⁶⁾
 120 140Gy, 4mm
 120Gy
 ,
 (postero ventral)
 가 50%
 ,
²⁾,
 , (hippocampus)
 .

1, 3 6
 T₁ T₂ - WI
 , 15
 60%, 80Gy
 6
 T2 - WI
 가
 1).
 140 160Gy 110 135Gy
 가 Christopher ²⁾ 34
 4 16
 (140 160Gy) , 22 (110 135Gy)
 , 6 58 (median 28)
 30 (79%) , 160Gy

Friehs⁶⁾⁷⁾ 3, 160Gy, 3, 2, 3, 4, 10)¹ 1, 150Gy, 3, 6, 90%, 4mm, Leksell, 85.7%, 64.3%

Young¹⁶⁾ 3, 3, 1, 4, 1, 3, 가 (free radical) 가

4mm, 10%, 12mm, 100Gy, 2)

가

결 론

4, 1, 5

- : 1999 11 10
- : 2000 3 27
- : 614 - 735 633 - 165
- : 051) 890 - 6144, : 051) 898 - 4244
- E - mail : paikns@att.co.kr

References

- 1) Altschuler E, Lunsford LD, Kondziolka D, Wu A, Maitz AH, Sciabassi R, et al : Radiobiologic models for radiosurgery. *Neurosurg Clin North Am* 3 : 61-77, 1992
- 2) Christopher MD, Deane BJ, Oleg VK, Rufus JM, Brian C, et al : Gammaknife radiosurgery for thalamotomy in Parkinsonian tremor : a five-year experience. *J Neurosurg* 88 : 1044-1049, 1998
- 3) Dogali M, Fazzini E, Kolodny E, Eidelberg D, Sterio D, Devinsky O, et al : Stereotactic ventral pallidotomy for Parkinson's disease. *Neurology* 45 : 753-761, 1995
- 4) Fox MW, Ahlskog JE, Kelly PJ : Stereotactic ventrolateralis thalamotomy for medically refractory tremor in post-levodopa era Parkinson's disease patients. *J Neurosurg* 75 : 723-730, 1991
- 5) Friedler J, Smith KA, Shetter AG, Ojakangas CL, Pachatz P : Spreadsheet for thalamotomy coordinate determination. *9th International Meeting of the Leksell Gamma Knife society. November 8-11, 1998, Hong Kong. SAR*
- 6) Friehs GM, Norn G, Ohye C, Duma CM, Marks R, Plombon J, et al : Leion size following gamma knife treatment for functional disorders. *Stereotact Funct Neurosurg* 66 (Suppl 1) : 320-328, 1996
- 7) Friehs GM, Ojakangas CL, Pachatz P, et al : Thalamotomy and caudatotomy with the gamma knife as a treatment for parkinsonism with a comment on lesion sizes. *Stereotac Funct Neurosurg* 64 (Suppl 1) : 209-221, 1995
- 8) Gildenberg PL : Functional Neurosurgery in Schmiegel (eds) :

- Operative Neurosurgical Techniques, indications, methods and results, 2nd ed, 1988, Vol 2, pp1042*
- 9) Giller CA, Dewey RB, Ginsburg MI, Mendelsohn DB, Berk AM : *Stereotactic pallidotomy and thalamotomy using individual variations of anatomical landmarks for localization. Neurosurg 42 (1) : 56-65, 1998*
 - 10) Hirato M, Ohye C, Shibasaki T, Nakamura M, Inoue HK, Andou Y : *Gamma knife thalamotomy for the treatment of functional disorders. Stereotact Funct Neurosurg 64 (Suppl 1) : 164-171, 1995*
 - 11) Jankovic J, Cardoso F, Grossman R, Hamilton WS : *Outcome after stereotactic thalamotomy for parkinsonian, essential, and other types of tremor. Neurosurg 37 : 680-687, 1995*
 - 12) Leksell L : *Cerebral radiosurgery : Gammathalamotomy in two cases of intractable pain. Acta Chir Scand 134 : 585-595, 1968*
 - 13) Lindquist C, Steiner L, Hindmarsh T : *Gamma Knife thalamotomy for tremor. Report of two cases. In Steiner L (ed) : Radiosurgery, Baseline and Trends, pp237-243 Raven, New York, 1992*
 - 14) Ohye C, Shibasaki T, Hirator M, Wada H, Hirato M, Kawashima Y : *Gamma thalamotomy for parkinsonian and other kinds of tremor. Stereotact Funct Neurosurg 66 (Suppl 1) : 333-342, 1996*
 - 15) Otsuki T, Jokura H, Takahashi K, Ishikawa S, Yoshimoto T, Kimura M, et al : *Stereotactic γ -thalamotomy with a computerized brain atlas : technical case report. Neurosurg 35 (4) : 764-768, 1994*
 - 16) Young RF, Shumway-Cook A, Vermeulen SS, Grimm P, Blasko J, Posewitz A, et al : *Gamma Knife radiosurgery as lesioning technique in movement disorder surgery. J Neurosurg 89 : 183-193, 1998*
 - 17) Young RF, Vermeulen SS, Grimm P, Posewitz A : *Electrophysiological target localization is not required for the treatment of functional disorders. Stereotact Funct Neurosurg 66 (suppl 1) : 309-319, 1996*