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The Changes of Touch Threshold on the Face of Patient with Trigeminal Neuralgia

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Abstract

Gamma knife surgery (GKS) has reported to be an effective and safety method for trigeminal neuralgia (TN). However, it has reported that after having received GKS, several percent of patients has felt numbness on the face. Then we measured the touch threshold on the facial skin to search the detail of them. Five patients diagnosed with TN of second branch were irradiated a maximum dose of 90 Gy at retro Gasserian after the target area were coordinated with MRI and CT. All patients were investigated the touch threshold on the lateral of nasal wing, subocular region and ear anterior parts using Semmes-Weinstein monofilaments before and 1, 3, 6, and 12 months after GKS. We compared with thresholds between healthy side and disease side. Though they had severe pain on the lateral area of nasal wing at first visiting, amblyaphia was assessed at the three areas, which showed individual characteristic. Touch threshold of totally 3 areas on the disease side was significant higher than that on the healthy side before and 1,3 months after GKS. This result suggested that the amblyaphia might be cognized on the wide area of face, which resulted from severe pain of TN and radiation.

Keywords: Gamma knife surgery, Trigeminal neuralgia, Touch threshold, Numbness

Introduction

Trigerminal Neuralgia (TN) is characterized by idiopathic and severe pain on the facial distribution of the trigeminal nerve. As a first line therapy, pharmacological approaches such as carbamazepine are selected for treatment of TN [1]. Then when the classical treatments such as medication, percutaneous nerve blocking or microvascular decompression are not effective, Gamma knife surgery (GKS) have considered as the method of trigeminal neuralgia treatment [2-4]. Gamma knife treatment as one of radio surgical therapy is minimally invasive technique and is suitable for elderly patients [5]. The method includes a Leksell Gamma Knife Unit, which releases 201 beams of ^{60}Co radiation in a concentric spherical environment, and the gamma beams are collected at one targeted area of the patient [6,7]. The treatment was introduced in Japan during 1990s, it has been applied schwannoma [8], metastatic brain tumor [9,10] and intractable pain cases [11].

There are many case reports which GKS was used for TN, as GKS's outcome, 75% to 90% of patients have obtained pain relief by 1 years' time [12,13]. Another report has showed that 89% of patients responded to treatment within 1 month, and total pain relief was achieved within 5 month [3]. However, on the other hand, Matsuda, et al. [14] have reported that trigeminal nerve dysfunction was assessed in the 49% of patients within 3 months after GKS. Brian, et al. [15] reported that stereotactic radiosurgery for TN was not successful in relieving facial numbness in 50% of patients after treatment. Both studies were evaluated using the Barrow Neurological Institute Numbness scale (BNI) [16]. And as side effects of GKS, loss of corneal reflex (6%) and facial numbness (5%) were the most common complications [17].

We have thought that the method is successful if the effects of a treatment exceed side effects. Moreover, the GKS treatment for TN was included the medical insurance adaptation in Japan from 2015. Therefore it is necessary to estimate an effect and the side effect of this therapy in greater detail. And there is no report which is described the measured value of touch sensation before and after GKS.

In this study, we investigated touch threshold on the facial area controlled by trigeminal nerve before and after GKS to assess the efficiency of this treatment.

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Patients and Methods

Patients

All patients gave informed consent in writing to participate in the study and to publish anonymized results.

The subjects in this study were 5 patients (2 males and 3 females) who were treated at neurological center of Tokyo Women`s Medical University with Gamma knife radiosurgery, and their age ranged from 60 to 72 years old (mean age: 65.2±6.2).

Thus all patients were diagnosed as trigeminal neuralgia of second branch before applying to our clinics and were treated with clonazepam. The medication was continued for one year after GKS.

Examination of sensation

Only one dentist asked patients their phenomenon and examined touch threshold on the lateral part of nasal wing, subocular region and ear anterior parts of both sides with closed eye condition using Semmes-Weinstein monofilaments (North Coast Medical, Inc.) before and 1, 3, 6, and 12 months after GKS. The filaments for measuring touch threshold were touched to skin in a 90 degree position, then were pressed until bending and kept about 1.5 seconds at the state. This examination was started from healthy side of each area with weakest filament marking (shortened FM hereafter) (2.52 gf/mm^2) and then the intensity was gradually increased. Touching by each FM was performed 3 times to the same place; the intensity recognized more than twice was accepted as the threshold of the day. The intensity of the FM was converted to pressure value (gf/mm^2) from the values reported by Bell-Krotoski [18]. These touch thresholds were compared with the disease side and healthy side.

Gamma knife irradiation

In neurological center of our institution, a local anesthesia was done at fixative part of Leksell frame, and the patient head was fixed with a position, at which the frame slope is in parallel to running of trigeminal nerve. After installing the frame, 0.5 mm MRI axial slices (3D heavily T2W1 (SSFP: TOSHIBA)) and 1.0 mm CT axial slices (bone image) to correct the distorted MRI images were taken and transferred to Gamma knife specific computer. A specific treatment planning software (Gamma Plan: ELEKTA Instrument AB) was used to correctly mark radiation planned retro Gasserian area (to the notch between petrous bone and trigeminal nerve) on the images. Then numerical values of 3 dimensional axes of coordinates were input into ModelC-APS (automatic positioning system: ELEKTA Instrument AB). Then 90 Gy of irradiation was applied on the retro Gasserian area.

Statistical analysis

The differences between the touch threshold on the disease side and on the healthy side before and after GKS were analyzed by Wilcoxon-test using SPSS ver.23 (IBM Inc, New York, USA). $P < 0.05$ was considered significant.

Results

Five patients diagnosed trigeminal neuralgia on the second branch (right side 3, left side 2) were taken part in this study. All patients have felt the severe pain on the location including the lateral part of nasal wing. The pain looked like electric chock from nasal wing on the face to head through sagittal direction. The pain decreased after GKS, but one patient had a heavy feeling at the disease side for long time, the others sometimes had discomfort at disease side until 6 months after GKS. Moreover, two patients had a feeling of slight numbness at 12 months after GKS.

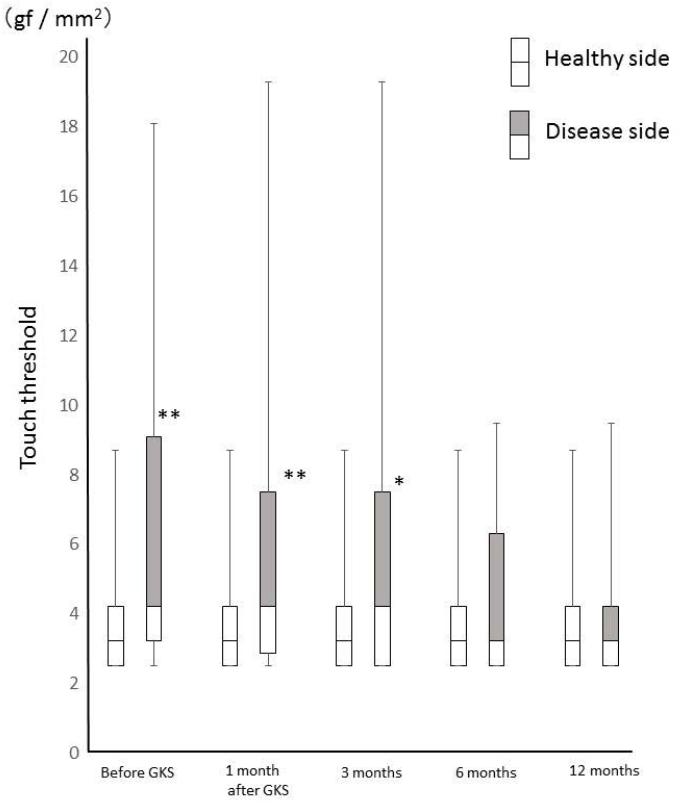
Before GKS, amblyaphia at the lateral of nasal wing of the disease side was recognized in all patients. And that was also found at the subocular region in 4 patients and at the ear anterior parts in 2 patients. At 1 month follow-up after GKS, one patient disappeared amblyaphia at the all regions. But, there were 4 patients with amblyaphia at anywhere on the face. Three of them had higher touch threshold at the subocular region or the ear anterior parts than one before GKS. At 3 month after GKS, another patient disappeared amblyaphia at the all regions. But, there were 3 patients who had amblyaphia anywhere of nasal wing, subocular region and ear anterior parts. At 6 month after GKS, there were 2 patients who had amblyaphia at the subocular region and the ear anterior parts. At 12 month after GKS, there was only one patient's which had amblyaphia at the subocular region (Table 1).

Patients Number	Before or after GKS	Touch threshold (gf/ mm^2)					
		Subocular	Region	Lateral of nasal wing		ear anterior parts	
		D	H	D	H	D	H
1	before	9.49	4.23	9.49	4.23	4.23	4.23
	1 month	6.30	4.23	9.49	4.23	6.30	4.23
	3 month	6.30	4.23	4.23	4.23	9.49	4.23
	6 month	6.30	4.23	4.23	4.23	6.30	4.23
	12 month	4.23	4.23	4.23	4.23	4.23	4.23
2	before	4.23	2.52	4.23	2.52	2.52	2.52
	1 month	2.52	2.52	2.52	2.52	2.52	2.52
	3 month	2.52	2.52	2.52	2.52	2.52	2.52
	6 month	2.52	2.52	2.52	2.52	2.52	2.52
	12 month	2.52	2.52	2.52	2.52	2.52	2.52
3	before	3.22	3.22	6.30	3.22	3.22	3.22
	1 month	4.23	3.22	6.30	3.22	4.23	3.22
	3 month	4.23	3.22	4.23	3.22	6.30	3.22
	6 month	3.22	3.22	3.22	3.22	3.22	3.22
	12 month	3.22	3.22	3.22	3.22	3.22	3.22
4	before	3.22	2.52	3.22	2.52	4.23	2.52
	1 month	3.22	2.52	3.22	2.52	2.52	2.52
	3 month	2.52	2.52	2.52	2.52	2.52	2.52
	6 month	2.52	2.52	2.52	2.52	2.52	2.52
	12 month	2.52	2.52	2.52	2.52	2.52	2.52
5	before	18.19	6.30	9.49	8.73	8.73	4.23
	1 month	8.73	6.30	19.28	8.73	9.49	4.23
	3 month	18.19	6.30	19.28	8.73	8.73	4.23
	6 month	9.49	6.30	8.73	8.73	6.30	4.23
	12 month	9.49	6.30	8.73	8.73	4.23	4.23

D: disease side H: Healthy side

Table1: Each patient's touch threshold on three areas.

Touch threshold of subocular region, the lateral of nasal wing and ear anterior parts on the healthy side and disease side before and 1,3,6,12 months after GKS.



The comparison of the totally touch threshold of subocular region, the lateral of nasal wing and ear anterior parts on the healthy side and disease side before and 1,3,6,12 months after GKS. (Wilcoxon-test; ** p<0.005, * p<0.05)

Figure 1: Touch threshold on the healthy side and disease side.

The median value (gf / mm^2) of the totally touch threshold of the three areas on the healthy side and disease side were 3.22, 4.34 (before GKS), 3.22 4.23 (at 1 month after GKS), 3.22 2.53 (at 3month), 3.22 3.22 (at the 6 month), 2.52 2.52 (at the 12 month), respectively. The threshold on the disease side were significant higher that one on the healthy side before and 1,3 months after GKS (Wilcoxon-test; before and 1 month after GSK P<0.005, 3 months after GKS P < 0.05) (Figure 1).

Discussion

TN is an intractable disease with symptoms of repeated sudden attacks of stabbing pain like electric shock on the facial distribution of the trigeminal nerve. Then those patients who did not respond medication therapy for TN have applied GKS for the last decades [19-22]. And complete pain relief after GKS was obtained in many cases [20]. On the other hand, Xu et, al. [23] have showed trigeminal nerve dysfunction of 10% within 3 months after radiation. Martínez, et al. [24] have reported that 32% trigeminal nerve sensory disturbance and 12% recurrence as the most common side effect occurred after GKS. These nerve dysfunctions have been estimated using BNI. Moreover, it was reported that if patients accepted repeat radiosurgery for recurrence, 75% trigeminal sensory loss was fond [25]. Sensory dysfunction or recurrence may be partially side effects of the radiations [26]. However, the expression of these side effects might depend on the target location and radiation dose. Much higher or weaker integrated dose predicts poor outcome after radiosurgery for trigeminal neuralgia. Therefore it is important to find best target position and better radiation dose.

In our study, five patients were recognized pain at the location including the lateral of nasal wing at first visiting, so we assessed higher touch threshold on the area compared with healthy side. The amblyaphia was also found at the subocular region in 4 patients and at the ear anterior parts in 2 patients before GKS. The higher tough threshold on the disease side might result from severe pain of TN. At 1 month follow-up after GKS, there were 4 patients with amblyaphia anywhere on the face. The patients got higher touch threshold on the respective area than before GKS. It was suggested that the amblyaphia could be the side effect of radiation. Such amblyaphia disappeared within 6 months after GKS. Higher tough threshold after GKS might be caused by pain as trigeminal neuralgia and side effect of radiation. According to the comparison of the totally threshold of three places, significant difference was recognized between disease side and health side before and 1,3 months after treatment. At the six months after GKS, the differences were not recognized at the disease side. These results suggested that the difference of threshold might disappear with the decrease in pain and progress of the treatment. 12 months later, there was one patient having amblyaphia on subocular region. However, there was not the further follow because the pain was relieved. In such a case, the subsequent medical support may be necessary in future.

Then, even if both sides were the same threshold, they said

that they felt like discomfort or mild numbness in disease side, or when they pushed there they felt light pain. We supposed that there was a difference between the real threshold and their feeling such as numbness. They emphasized the refractory pain than numbness on the disease side at the first medical examination. Because the bothersome pain lets them make a daily activity such as eating, speaking or laughing difficult, which decreases QOL?

Our results showed that though higher touch threshold was recognized in the 3 months after GKS, so all patients' pain for TN were reduced; it was thought that this therapeutic method was successful. Niranjan A, et al. [27] reported that GKS was associated with 60-90% rate of pain relief in patients with refractory trigeminal neuralgia. We also obtained an affective result from GKS for TN.

In this study, we recognized for the first time that even if patients felt numbness on disease side compared with healthy side, the touch threshold on both side were the same vale. Therefore, finally Gamma knife treatment may provide a great contribution for TN.

Conclusions

Higher touch threshold on the disease side was found before GKS, which resulted from severe pain. The amblyaphia recognized after GKS might result from radiation. However, such amblyaphia was gradually improved with pain relief within 6 months. Radiosurgery for trigeminal neuralgia is an effective treatment which induces pain relief and sense improvement.

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