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The change of the trigeminal nerve root after the gamma knife treating Chinese patients with primary trigeminal neuralgia

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ABSTRACT

Objective: To understand the mechanism of the gamma knife treating the trigeminal neuralgia. **Materials and Methods:** Using MASEP-SRRS type gamma knife treatment system, 140 Chinese patients with trigeminal neuralgia (NT) were treated in our hospital from 2002 to 2010, in which the pain relief rate reached 95% and recurrence rate was 3% only. We investigated the effect of the gamma knife treatment on the trigeminal nerve root in 20 Chinese patients with primary trigeminal neuralgia by the magnetic resonance imager (MRI) observation. **Results:** ① the cross-sectional area of trigeminal nerve root became smaller and MRI signals were lower in the treatment side than those in the non-treatment side after the gamma knife treatment of primary trigeminal neuralgia; ② in the treatment side, the cross-sectional area of the trigeminal nerve root decreased significantly after the gamma knife treatment; and ③ the straight distance between the trigeminal nerve root and the brainstem did not change after the gamma knife treatment. **Conclusion:** The pain relief induced the gamma knife radiosurgery might be related with the atrophy of the trigeminal nerve root in Chinese patients with primary trigeminal neuralgia.

Keywords: Gamma knife; Trigeminal nerve root; Primary trigeminal neuralgia; MRI

1 Introduction

Trigeminal neuralgia (TN) is a neuropathic disorder characterized by episodes of intense pain in the face, originating from the trigeminal nerve [2]. The disorder is typically characterized by episodes of intense facial pain that last from a few seconds to several minutes or hours and may occur paroxysmally. Individual attacks usually affect one side of the face at a time, which 10-12% of cases are bilateral, or occurring on both sides [3].

It was once believed that the nerve was compressed in the opening from the inside to the outside of the skull[1]; but newer leading research indicates that it is an enlarged blood vessel - possibly the superior cerebellar artery - compressing or throbbing against the microvasculature of the trigeminal nerve near its connection with the pons. Such a compression can injure the nerve's protective myelin sheath and cause erratic and hyperactive functioning of the nerve. This can lead to pain attacks at the slightest stimulation of any area served by the nerve as well as hinder the nerve's ability to shut off the pain signals after the stimulation ends [12].

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trigeminal neuralgia. All of the MRI images showed the structures of the trigeminal nerve root were good both before and after the gamma knife treatment (Fig. 2). The cross-sectional area of trigeminal nerve root and MRI signals between the treatment side and non-treatment side showed different before the gamma knife treatment of the trigeminal neuralgia (Fig. 3).

The cross-sectional area of trigeminal nerve root became smaller and MRI signals showed lower in the treatment side than those in the non-treatment side (Fig. 4 and Fig. 5). Compared with that before the gamma knife treatment, the cross-sectional area of the trigeminal nerve root decreased significantly from 5.74±0.4 mm^2 to 3.52±0.8 mm^2 after the gamma knife treatment in the treatment side (p<0.01); but in the non-treatment side, the cross-sectional area of the trigeminal nerve root did not change after the gamma knife treatment (5.56±0.3 mm^2 vs. 5.44±0.5 mm^2, p>0.05) (Fig. 6).

Change of the straight distance between the trigeminal nerve root and brainstem: Compared with that before the gamma knife treatment, the straight distance between the trigeminal nerve root and the brainstem did not change (30.6±2.5mm vs. 9.4±2.3mm, p>0.05) (Fig. 7).

4 Discussion

It has been taking advantage in the pain relief for the gamma knife radiosugery to treat primary trigeminal neuralgia, which has high efficacy rate (88-96%), good quality life rate (about 85%) and low complication and recurrence rate (4-12%) [[10, 17]. Compared with the classic vascular decompression of the trigeminal nerve, it was satisfied from less complication, efficiency rate and patients' satisfaction [7, 11]. It has been regarding as the first choice for patients in line with indication [5, 6]. The cause of primary trigeminal neuralgia was considered concerned with some local factors currently, such as vascular compression, inflammation, arachnoid adhesions, the endocranium hyperplasia and viral infection [8]. The present study also showed that the curative effect rate of pain-relief was very high and the facial numbness recurrence rate was very low in all 20 Chinese patients with primary trigeminal neuralgia after the gamma knife treatment.

For the gamma knife radiosurgery treating primary trigeminal neuralgia, the target doses of 60 and 70 Gy had very little impact on the structure of the trigeminal nerve; irradiation at 80 Gy could cause partial degeneration and loss of axons and demyelination; and a 100-Gy dose can cause some necrosis of neurons [16]. Using an effective MRI inspection in 89 patients, 82 patients could be seen vascular compression, which mainly occurred by the superior cerebellar artery with the percentage of 78%[9]. The present data showed that the cross-sectional area of the trigeminal nerve root significant atrophy in corona view with an average decline of 39.8% 12 months after the gamma knife treatment in Chinese patients with primary trigeminal neuralgia, i.e. the trigeminal nerve trunk in the treatment side showed lower signal change after the treatment than that before the treatment; and the straight distance between the trigeminal nerve root and the brainstem did not change after the gamma knife radiosurgery. It indicated that the trigeminal nerve was neurodegenerated by the radiotreatment, while the structure of brain stem was not affected. We speculated that the nerve shrinkage and sheath caused by the radiosurgery led to reduce gradually and terminate the pseudo-synaptic formed between the nerves and blood vessels to relieve the clinical symptoms in Chinese patients with primary trigeminal neuralgia. Lorenzoni et al. also found that 24% of patients had the nerve atrophy and 33% of patients had the neurological shift in MRI views after Gamma knife treatment [9]. The follow-up results of the present study also showed that the pain process of trigeminal neuralgia matched with the trigeminal nerve neuratrophic process after gamma knife treatment, i.e. the pain relief rate was 100% one-month after the treatment and the pain relief rate remained steadily in 95% one-year after the treatment; and the incidence of prosopo-numbness after treatment reached 75% and gradually decreased to 15% after one year.

In conclusion, the present study made clear that ① the cross-sectional area of trigeminal nerve root became smaller and MRI signals were lower in the treatment side than those in the non-treatment side after the gamma knife treatment of primary trigeminal neuralgia; ② in the treatment side, the cross-sectional area of the trigeminal nerve root decreased significantly after the gamma knife treatment; and ③ the straight distance between the trigeminal nerve root and the brainstem did not change after the gamma knife treatment. The data suggested that the pain relief induced the gamma knife radiosurgery might be related with the atrophy of the trigeminal nerve root in Chinese patients with primary trigeminal neuralgia.

5 Figure Legends

Figure 1: Effect of the gamma knife treatment on primary trigeminal neuralgia. ▲ indicates the number of the patients of pain-relief; ■ indicates the number of the patients of facial numbness.

Figure 2: The MRI screenage of the trigeminal nerve roots befroe the gama knife treatment.

Figure 3: The MRI screenage of the trigeminal nerve roots after the gama knife treatment.

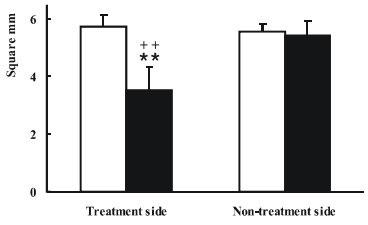

Figure 6

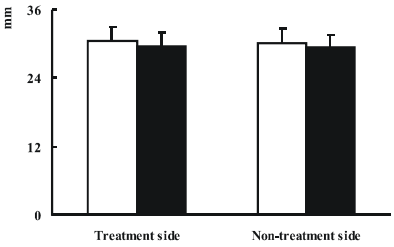

Figure 7

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