

# Clinical Effect of Partial Sensory Root Rhizotomy on Recurrence of Multiple Sclerosing Trigeminal Neuralgia After Percutaneous Balloon Compression

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## Research article

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# Abstract

**Objective** To investigate the Clinical effect of partial sensory root rhizotomy(PSR) on recurrence of multiple sclerosing trigeminal neuralgia(TN-MS) after percutaneous balloon compression(PBC).

**Methods** A retrospective analysis of the clinical data of 21 cases of recurrent multiple sclerosis trigeminal neuralgia after PBC who were treated with PSR in the Department of Neurosurgery of Xinxiang Central Hospital from January 2012 to July 2018; The diagnosis of MS was made by McDonald criteria, and using MRI to exclude REZ Regional blood vessels compress nerves; analysis of patients' preoperative and postoperative Visual Analogue Score (VAS), VAS 0-3 points means effective, 4 points and above means invalid or recurrence.

**Results** Preoperative VAS: 8 -10 points in 21 cases, 1 day and 6 months after surgery VAS: 0-3 points in 21 cases, effective rate 100%; 12 months after surgery: 4 points in 2case, effective rate 95%, recurrence rate 5%; 18 months after surgery, 4 cases scored above 4, the effective rate was 81%, and the recurrence rate was 19%. The average point of VAS after PSR at 1 day, 6M, 12M, and 18M were lower than PBC,  $P<0.05$ , and the difference was statistically significant. The postoperative recurrence rate of PSR at 6M, 12M, and 18M is lower than that of PBC,  $P<0.05$ , and the difference is statistically significant. All 21 patients had facial sensation loss after surgery without major complications such as intracranial hemorrhage, facial palsy, and cerebrospinal fluid leakage. 1 case of intracranial infection.

**Conclusion** PSR is effective in the treatment of TN-MS and can be used as a treatment for recurrence after PBC.

## Introduction

TN is a kind of episodic electric shock-like pain, which is mostly distributed in one or more branches of the trigeminal nerve. It can be induced by touching, windward, chewing, washing, shaving, etc. It can be divided into classic and secondary types, most of which belong to classic type, the cause of the disease is mostly abnormal arteries or veins compressing nerve root entry zone (REZ). Microvascular decompression (MVD) can solve the problem from the etiology, with good treatment effect, fewer complications, and low recurrence rate<sup>[1]</sup>. Secondary TN is mostly caused by tumors of the cerebellopontine angle, aneurysms, MS, etc.<sup>[2-3]</sup>, among which MS is a chronic inflammatory disease of central nervous system demyelination and axon degeneration. the more common symptom is neuropathic pain. Among different types of neuropathic pain, TN is a characteristic and refractory neuropathic pain state<sup>[4]</sup>, called TN-MS. Studies shown that the incidence of TN -MS patients is 20 times that of the general population. It has its own characteristics. Unlike classical TN. The bilateral incidence of TN-MS is as high as 31%, younger onset, low incidence in the first branch<sup>[5]</sup>. TN-MS patients' daily activities, mood, and work are all seriously affected<sup>[6]</sup>, treatment is difficult, and there are various methods. In addition to pharmacotherapy, radiofrequency ablation, glycerol ablation, PBC, stereotactic radiotherapy, MVD and PSR. Due to the poor effect of drug treatment, some patients choose invasive

treatment, different medical centers and departments recommend different methods. In China, PBC treatment methods are gradually increasing, but the treatment effect for TN-MS is not good. TN-MS patients who recurrence after PBC treatment must face another choice of treatment methods. PBC and MVD operations have been performed in our center for many years with mature technology. From January 2012 to July 2018, partial sensory rhizotomy (PSR) was used to treat 21 cases of TN-MS patients who relapsed after balloon compression surgery. The summary is as follows:

## Methods

### Screening and Evaluation Methods:

The clinical data of 21 patients with recurrent TN-MS after PBC in neurosurgery department of Xinxiang Central Hospital from January 2012 to July 2018 were retrospectively analyzed. All patients were diagnosed as MS by McDonald's diagnostic criteria [7]. MRI scan, 3D-FIESTA and 3D-TOF sequence were performed, excluding intracranial tumor, REZ without vascular compression nerve; medical treatment effect is poor or intolerable; excluding severe cardiopulmonary dysfunction, coagulation dysfunction, incision inflammation and other surgical contraindications. The general information of the patients was recorded, and the VAS of PBC and PSR before operation, 1 day, 6 months, 12 months and 18 months after operation were compared and evaluated; the postoperative complications were analyzed.

### Statistical Methods

SPSS 21.0 statistical software was used to analyze the data. Count data conforming to normal distribution are expressed as  $\pm s$ , independent sample t-test is used for comparison between groups; measurement data is expressed as (%), and  $\chi^2$  test is used for comparison between groups. The difference was statistically significant when  $P < 0.05$ .

### Surgical Methods

**PBC:** Patient was placed in a supine position and was given general anesthesia via oral intubation. The puncture point was 2.5cm outside the mouth corner of the affected side. The puncture direction was 3cm in front of the external ear canal at the level of the zygomatic arch and the pupil on the ipsilateral side. Zygomatic arch and mandibular angle overlap on both sides. One hand supports the same side of the buccal mucosa, the other hand is guided by the C-arm machine to pierce the foramen ovale with a 14-gauge puncture needle, pull out the needle core, and introduce the Forgarty balloon into the Meckel cavity after venting, and then inject into the balloon. Iodine contrast agent start to increase gradually from 0.2ml, observe the balloon shape until the ideal pear shape appears, continue to compress for 2.5 minutes, some patients could not show the pear shape after several adjustments, the compression time was then increased to 3 minutes, take out the iodine imaging remove the puncture needle, end the operation, and press the puncture point for 5 minutes to stop bleeding.

**PSR:** All patients underwent general anesthesia via oral intubation, lateral position, straight incision in the hairline, up to 1cm above the apex of the digastric sulcus, about 6cm in length, layer by layer incision on the scalp, muscle, and distraction with mastoid retractor, the star point is drilled, the rongeur expands the bone window to expose the intersection of the transverse and sigmoid sinuses, bone wax seals the mastoid air chamber, and opens the dura mater after arc-shaped incision to release cerebrospinal fluid, separate the surrounding arachnoid membrane under a microscope, explore the trigeminal nerve, adjust the microscope angle, observe the REZ area, no obvious vascular compression was confirmed, and approximately 2/3 of the trigeminal sensory root near the brainstem was microscopically dissected to achieve complete hemostasis. Suture the dura mater, fix the skull with titanium plates and nails, and suture the scalp layer by layer.

## Results

Among the 21 patients, 8 were male (38%), 13 were female (62%), 10 were left (47.6%), 9 were right (42.8%), and 2 were bilateral (9.5%). The medical history of MS was 6-11 years, with an average of  $7.76 \pm 1.48$  years; the medical history of TN was 5-8 years, with an average of  $5.95 \pm 1.09$  years. Preoperative VAS: 8-10 points in 21 cases, 1 day and 6 months after surgery VAS: 0-3 points in 21 cases, effective rate 100%; 12 months after surgery: 4 points in 2 cases, effective rate 95%, recurrence rate 5%; 18 months after surgery, 4 cases scored above 4, the effective rate was 81%, and the recurrence rate was 19%. The average score of VAS after PSR at 1 day, 6M, 12M, 18M were lower than PBC,  $P < 0.05$ , and the difference was statistically significant, which is shown in Table 1 and figure 1. The postoperative recurrence rate of PSR at 6M, 12M, and 18M is lower than that of PBC,  $P < 0.05$ , and the difference is statistically significant, which is shown in Table 2 and figure 2. Complications: after PBC operation, 7 cases of masticatory muscle strength decreased and recovered at 6 months follow-up; after PSR operation, all 21 patients had facial sensation loss after operation, 1 case of intracranial infection, no decrease in masticatory muscle strength, no weakened corneal reflex, no intracranial hemorrhage, or facial paralysis, Cerebrospinal fluid leakage, and other serious complications.

## Discussion

The treatment methods of TN-MS include drugs, gamma knife, balloon compression, MVD and PSR, but the treatment effects are different. Giulia Di Stefano<sup>[8]</sup> summarized the articles published in recent years on drug treatment of TN-MS and proposed that patient cannot tolerate the central sedation and exercise side effects of carbamazepine, oxcarbazepine, lamotrigine, gabapentin, and pregabalin, and most patients cannot obtain satisfactory curative effects. Further development of new selective and well tolerated sodium channel blockers is still necessary. Zakrzewska<sup>[9]</sup> are conducting a randomized clinical trial of a new selective sodium channel blocker, hoping that the drug will have a good therapeutic effect and fewer side effects, and alleviate the suffering of patients.

Helis<sup>[10]</sup> reported a group of cases of gamma knife treatment of TN-MS, 82% of patients had a good pain relief rate after surgery. The average relief time was about 1.1 years. After 1 year, 3 years, and 5 years

follow-up, the average remission rate is 51%, 39%, 29%, the recurrence rate is high, and the long-term effect is poor performance. Alvarez-Pinzon<sup>[11]</sup> believe that the minimal invasiveness and satisfying results of GKRS support its use as the first-line treatment of TN in patients with MS. However, most of the therapeutic effects of the gamma knife are gradually effective half a year after the operation, and most patients cannot tolerate the pain during this period.

Pinzon<sup>[11]</sup> believes that the effectiveness of PBC is confirmed in treatment TN-MS. Asplund<sup>[12]</sup> reported a group of cases, 66 TN-MS patients underwent 111 trigeminal nerve semilunar segment microballoon compression, the immediate postoperative effective rate was 67%, and the average recurrence time was 8 months. Martin<sup>[13]</sup> reported 17 cases, and the immediate postoperative effective rate was 82%. Nicola Montano<sup>[14]</sup> reported 21 cases, 17 cases were relieved after PBC treatment, the effective rate was 80.95%, the pear-like shape of the balloon at the operation were associated to higher pain-free survival, which is consistent with our experience. However, Baabor<sup>[15]</sup> reported that patients with classic TN who received PBC had an immediate postoperative effective rate of 93% and an overall effective rate of 99%, indicating that PBC is not as effective as typical TN in treating TN-MS. From my perspective, the inconsistent results may be related to technology, case selection, and sample size, however, its efficacy is not as good as that of typical TN. In our center, TN-MS patients who have failed medical treatment are more inclined to undergo PBC surgery, because the surgical trauma is not more obvious than the gamma knife, and it is effective immediately after the operation.

MVD is the best treatment for classic TN with responsible vascular compression, which has become a consensus, but the role of responsible vascular in TN-MS and the therapeutic effect of MVD are still not fully understood. Truini<sup>[16]</sup> believes that a dual concurrent mechanism explains trigeminal neuralgia in patients with multiple sclerosis. But Noory<sup>[17]</sup> has different opinion on it, he believes that neurovascular contact plays no role in trigeminal neuralgia secondary to MS. Paulo<sup>[18]</sup> reported 33 cases of MVD in the treatment of TN-MS, and a follow-up of 53.5 months after surgery indicated that the pain relief rate was 67%. They believed that although MVD is not as effective as classic TN in the treatment of TN-MS, it can still be recommended. Choose, and the more severe the preoperative pain, the worse the surgical effect. We do not do much discussion here about regarding MVD and TN-MS.

Trigeminal nerve sensory root cut was first proposed by Dandy in the 1920s. At first, it was completely cut, and later, to preserve the sense of touch, it was changed to partial cut, that is, PSR operation. Later, it was gradually applied to patients who did not have a clear responsibility vessel in the REZ area during MVD surgery and those who were ineffective or recurred after MVD surgery. The follow-up effect was good. Yin Liu<sup>[19]</sup> believe that in the postmenstrual fossa MVD surgery, there is no obvious vascular compression, the decompression effect is not satisfactory, and the patient's age is more than 60 years old. It is appropriate to adopt PSR surgery, and its effective rate is the same as that of MVD. The tolerance for numbness is much greater than pain. Terrier<sup>[3]</sup> reported a group of cases, the postoperative pain relief rate was 86.4%, and the 5-year follow-up recurrence rate was 31.5%. Recently, Bigder<sup>[20]</sup> proposed that

PSR can prolong pain recurrence time and reduce pain score more than other methods in the treatment of TN-MS.

In this group of cases, 8 of them are male (38%), 13 of them are female (62%), 10 were left (47.6%), 9 were right (42.8%), and 2 were bilateral (9.5%). The history of MS is 6-11 years, with an average of  $7.76 \pm 1.48$  years; the history of TN is 5-8 years, with an average of  $5.95 \pm 1.09$  years, which is not consistent with the results of Cruccu<sup>[5]</sup>, which may be due to our small sample size. This study showed that the pain relief rate on the first day after PSR was 100%, the follow-up 6M, 12M, and 18M relief rates were 100%, 95%, 81%, and the recurrence rates were 0, 5%, and 19%, respectively. The effect is better than the 86.4% reported by Terrier<sup>[3]</sup>, but not as good as non-TN-MS, may be related to the history of PBC surgery in this group of patients and the degree of trigeminal nerve cut during the operation, and the long-term prognosis still needs further observation. The comparison of the two treatment methods before and after shows that PSR has a better VAS score drop and lower recurrence rate than PBC; all patients have facial sensation after surgery, but it is tolerable, and experienced significantly better than pain, and no corneal reflex attenuation, which did not affect life; 1 case of intracranial infection, but there are no serious complications such as intracranial hemorrhage, facial paralysis, cerebrospinal fluid leakage after PSR; 7 cases of chewing function decline after PBC, but they are completely improved after half a year. This is because PBC destroys trigeminal semilunar ganglion, motor nerves are affected, and PSR only selectively cuts off part of the sensory root. But at the same time, PSR also has its drawbacks, because the craniotomy is very traumatic. Although there were no serious complications in these 21 patients, it did not mean that they would not occur, probably because the sample size was too small. It has been reported that the mortality rate of MVD is 0.4%<sup>[21]</sup>. And the average length of stay and cost of PSR is higher than that of PBC. Zakrzewska<sup>[22]</sup> conducted a systematic retrospective analysis and concluded that the treatment effect of TN-MS is poor compared with classic TN. The 2-year recurrence rate of various surgical treatments is approximately 50%. There is no evidence that medications or early surgery are effective, but we believe that TN-MS patients who relapse after PBC should still be actively treated. PSR can be determined as a recommended treatment.

## Limitations

This study is a retrospective study with few cases, the follow-up time was short and only included MS-TN patients who relapsed after balloon compression therapy. The results may be different from the results of using PSR in the first treatment, and are not compared with other treatments such as gamma knife or glycerol injection.

## Conclusions

In short, PSR has a lower pain recurrence rate and a more significant reduction in VAS than balloon compression. For patients who relapse after PBC, PSR is worth recommending, however, the overall prognosis is not as good as that of classical TN, and drug therapy awaits new findings.

# Declarations

## Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, and publication of this article.

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## Tables

Table 1.

Comparison of average scores of VAS before and after two operations

	Zero	1Day	6M	12M	18M
PBC	8.6±0.7	1.3±0.9	1.8±1.0	2.9±1.5	4.3±1.4
PSR	8.5±0.5	0.5±0.8	0.8±1.0	1.6±0.9	2.7±1.6
<i>t</i>	0.533	3.044	3.24	3.406	3.449
<i>P</i>	0.597	0.004	0.002	0.001	0.001

Table 2.

Comparison of recurrence rate between two operations

	6M	12M	18M
PBC	9.5	28.6	61.9
PSR	0	9.5	19.0
$\chi^2$	9.974	11.82	38.26
<i>P</i>	0.002	<0.001	<0.001

## Figures

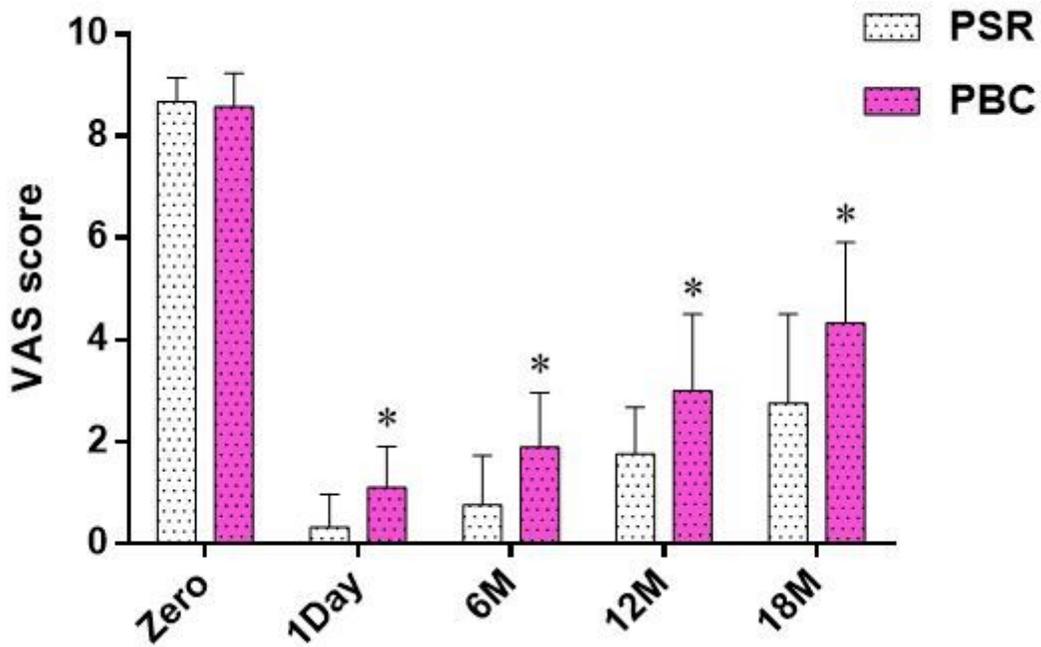
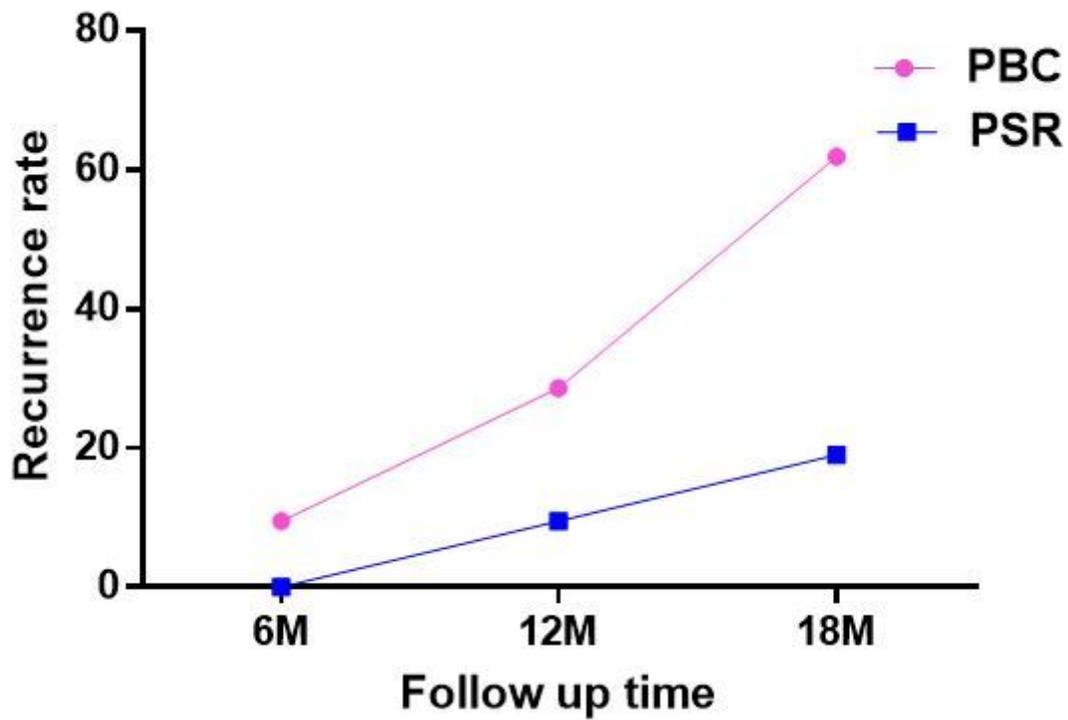


Figure 1

Comparison of average scores of VAS before and after two operations.



## Figure 2

Comparison of recurrence rate between two operations.