Gamma Knife Surgery for Recurrent Trigeminal Neuralgia in Cases with Previous Microvascular Decompression

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■ BACKGROUND: **Microvascular decompression (MVD) and Gamma Knife surgery (GKS) are the primary treatments for trigeminal neuralgia (TN). However, many patients require further surgical treatment after initial surgery for recurrent TN. The aim of this study was to evaluate efficacy and safety of GKS for recurrent TN cases with prior MVD.**

■ METHODS: **From October 2008 to June 2015, 658 patients at West China Hospital underwent GKS as the only surgical treatment, and 42 patients underwent GKS with prior MVD. The single 4-mm isocenter was located at the cisternal portion of the trigeminal nerve in all patients. Median maximum prescription dose was 85 Gy (range, 70—90 Gy).**

■ RESULTS: **Median follow-up time was 6.2 years (range, 1.1—10 years). The percentage of patients with or without previous MVD within 1 year was 56.81%, and the percentage of patients who were pain-free was 74.74%. The recurrence rates within 10 years were 49.11% and 43.74% for patients with and without MVD, respectively. Also, 9.52% and 11.04% of patients with and without previous MVD experienced complications as a result of GKS during the long-term follow-up period. Patients who underwent previous MVD showed a significantly lower pain-free rate compared with patients without previous MVD ($P = 0.01$). There was no statistical significance in the recurrence rate ($P = 0.82$) or the complications ($P = 0.93$) in the 2 groups during the long-term follow-up period.**

■ CONCLUSIONS: **For patients with recurrent TN who previously underwent MVD, GKS remains an efficacious and safe mode of treatment.**

INTRODUCTION

Patients with medically refractory trigeminal neuralgia (TN) usually resort to surgical treatments to alleviate their pain. Surgical treatments include microvascular decompression (MVD),[1] balloon microcompression,[2] radiofrequency lesioning,[3,4] glycerol rhizotomy,[5] cortical stimulation,[6] and stereotactic radiosurgery.[7,8] However, patients who undergo surgical treatments are at risk for recurrent TN. In the literature, the recurrence rate of TN after MVD is 1%—5% annually[1,9-11] and 15%—35% over the long-term.[12] For recurrence of TN after Gamma Knife surgery (GKS), the long-term rate is 5%—32%.[13-15] The recurrence rate of pain after radiofrequency lesioning is 18%—80%[16-18] and after glycerol rhizotomy is 11% to 41%.[19,20] Exact data for other surgical treatments are not available.

GKS is a minimally invasive treatment for patients with TN. For a fraction of patients who have surgical contraindications or who cannot undergo craniotomy, GKS provides a relatively acceptable option as an initial form of treatment. For recurrent TN, GKS is still a surgical option. The effect of initial treatment on secondary treatment, especially in the setting of previous GKS with MVD, has been reported.[21,22] MVD has been performed without additional difficulty in patients who underwent previous GKS, and patients

Key words
- Gamma knife surgery
- Microvascular decompression
- Recurrent trigeminal neuralgia

Abbreviations and Acronyms
BNI: Barrow Neurological Institute
GKS: Gamma Knife surgery
MVD: Microvascular decompression
TN: Trigeminal neuralgia

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who have undergone MVD as the only surgical treatment have experienced similar success rates. However, whether previous MVD has an effect on subsequent GKS as a form of retreatment for recurrent TN is unknown. The purpose of the present study was to evaluate the safety and efficacy of GKS for patients with recurrent TN with previous MVD. Furthermore, pain-free rate, recurrence rate, and complications in patients who underwent GKS with previous MVD were compared with those in patients who underwent GKS as their only treatment. Stereotactic radiosurgery is also discussed.

MATERIALS AND METHODS

Enrollment Criteria of Study Subjects

A retrospective study was conducted. The diagnosis of trigeminal pain in all subjects in this study was in agreement with the International Headache Society.[23] Trigeminal pain was classified as idiopathic TN type 1 and TN type 2 as proposed by Eller.[24] Patients were divided into 2 groups according to whether they underwent previous MVD. The patients who underwent MVD previously fulfilled the diagnostic criteria of TN type 1[24] and had explicit vascular compression on imaging (Figure 1A and C). Patients with a history of multiple sclerosis or megadolichobasilar artery compression were excluded from this study.[25-27] According to these criteria, there were 658 patients at West China Hospital who underwent GKS as their only surgical treatment and 42 patients who underwent GKS with prior MVD who were enrolled from October 2008 to June 2015 in this study. The characteristics of the 2 groups are summarized in Table 1.

Radiosurgical Treatment for TN

Before radiosurgical treatment, all patients underwent 3.0T magnetic resonance imaging after they were administered local anesthesia with the Leksell Model G stereotactic frame (Elekta Instruments AB, Stockholm, Sweden). The scanning sequences included contrast-enhanced T1-weighted and T2-weighted images (0.5-mm thickness).

All treatments were performed using the Leksell Knife Model C (Elekta AB) with a single 4-mm isocenter. The target was located at the cisternal portion of the trigeminal nerve. The median distance from the target center to the anterior portion of where the nerve emerged was 7.4 mm (range, 4.1—10.6 mm). The locations of radiosurgical targets are shown in Figure 1B and D. The median maximum prescription dose was 85 Gy (range, 70—90 Gy) based on a previous study.[28] The radiation dose received by the brainstem was also calculated and was limited to 15 Gy by scaling down the dose and applying the plug technology.

Follow-Up and Assessments

All patients received follow-up. Patients received follow-up assessments at 1 month, 3 months, 6 months, and 12 months after GKS and yearly thereafter until the patient was lost to follow-up. The initial follow-up assessment was performed as an outpatient, and long-term follow-up assessments was by telephone review and other means. The assessments included pain relief, drug dosages, and complications.

The efficacy of GKS was evaluated using the Barrow Neurological Institute (BNI) scale.[29] According to the BNI scale, BNI grades I—IIIa were defined as successful GKS treatment. Patients with recurrence went from BNI grades I—IIIa to a lower grade. Complications included abnormal corneal reflexes, dysesthesias, paresthesias, anesthesia dolorosa, and jaw motility. Hypoesthesia was assessed using the BNI facial hypoesthesia scale.[30] Any other uncomfortable symptoms associated with GKS were also monitored during the follow-up.

In addition to the aforementioned assessments, patient satisfaction was investigated in a manner similar to other studies.[31] Patient satisfaction was classified on 3 levels: no regret, no opinion, and regret. The purpose of this investigation was to evaluate the efficacy of GKS not only from the physician's point of view but also from the point of view of the patient.

Statistical Analysis

The analysis of pain-free, recurrence, and complication rates in the 2 groups was determined using the Kaplan-Meier method. The χ^2 test and Fisher test were performed for qualitative variables. For quantitative variables, Kaplan-Meier curves were used to determine survival between the different groups and were compared

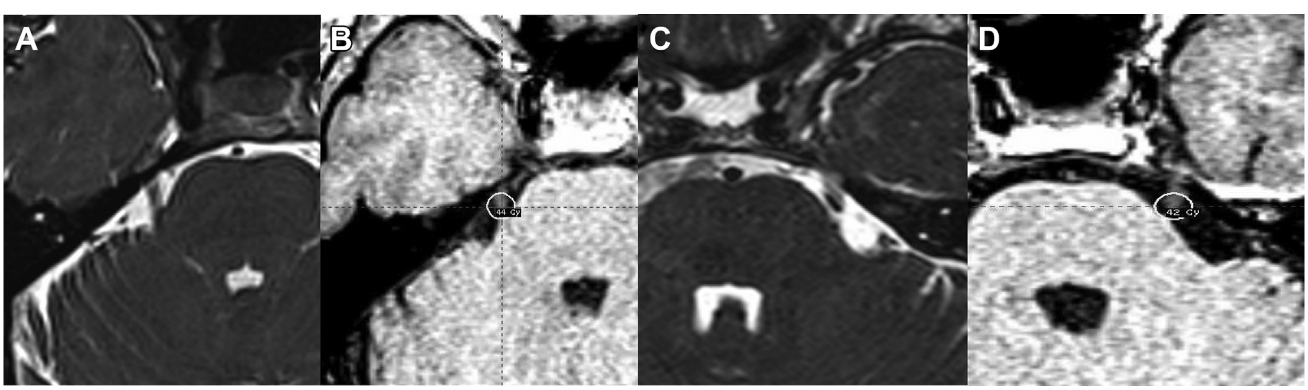

Figure 1. (**A**—**D**) Vascular compression and location of radiosurgical targets in 2 cases. (**A** and **C**) Compression of the vasculature in trigeminal neuralgia (low signal on T2-weighted image crossing trigeminal neuralgia). (**B** and **D**) Location of radiosurgical targets.