Case study

Leksell Gamma Knife® radiosurgery for trigeminal neuralgia associated with multiple sclerosis

Case

Trigeminal neuralgia associated with multiple sclerosis

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Overview

Trigeminal neuralgia (TN) is a neuropathic pain disorder involving one or more branches of the trigeminal nerve and associated with severe facial pain. Multiple sclerosis patients with TN often have poor pain control with conservative medication treatment, which dramatically decreases the quality of life for these individuals. [1] Alternative treatment options, such as Gasserian ganglion glycerol rhizolysis, radiofrequency thermocoagulation, balloon compression, and microvascular decompression, have a greater morbidity rate (0-76.5% complication rate) and are not usually suitable for these patients. [2] Stereotactic radiosurgery (SRS) using Leksell Gamma Knife® is the least invasive surgical technique for multiple sclerosis-related TN and has very low morbidity. [3]

In this case, a 39-year-old male patient with a history of multiple sclerosis had experienced right-side facial pain for two years. According to neurological examination, V1, V2, and V3 trigeminal nerve branches were involved. Slight hypoesthesia was observed in the forehead and right cheek. Facial pain only partially responded to conservative treatment, scoring IV on the Barrow Neurological Institute (BNI) pain intensity scale. The patient had not received any previous surgical treatments before stereotactic radiosurgery.

Rationale for Gamma Knife radiosurgery

Gamma Knife radiosurgery was recommended as a complementary treatment for this patient because it is a non-invasive technique with very low toxicity. [3] It is an effective and very safe treatment option for TN that results in reasonable pain reduction, reaching 83%, 71%, and 71% at one, three, and five years, respectively [4].

SRS treatment of TN requires high irradiation (> 80 Gy) of a point in the trigeminal nerve that is close to the brain stem. Gamma Knife radiosurgery provides superior dose gradients compared to other irradiation techniques [5], allowing safe prescription of 90 Gy to the target.

Treatment protocol

We immobilize all TN patients with Leksell G frame fixation under local anesthesia. No sedation is required. Stereotactic T1 magnetization-prepared radio-frequency pulses and rapid gradient-echo (MP-RAGE) MRI images are used for manual treatment planning using Leksell GammaPlan® 11.3.2. For trigeminal neuralgia treatment planning we use a single 4 mm shot approach based on the best clinical practice of leading European Gamma Knife centers. The shot is placed 7.5 mm anterior to the root entry zone (REZ). [6] We use a 90 Gy prescription dose at 100% isodose for all TN patients. The 90% isodose (81 Gy) should cover the entire trigeminal nerve with full 4 mm collimator settings. We strongly avoid sector blocking because irradiation of a longer portion of trigeminal nerve increases the risk of late hypoesthesia and has no significant effect on pain control. [7, 8]

The 32 Gy isodose must not touch the brain stem, and 0.1 cc volume of it must receive less than 10 Gy.

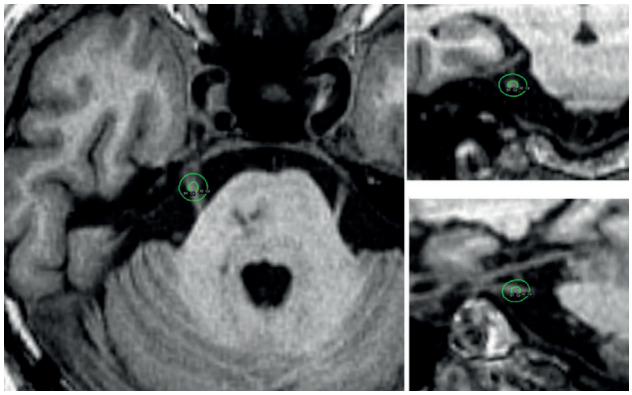

Figure 1.
Gamma Knife SRS treatment planning using non contrast enhanced T1 MP-RAGE MRI images.

The Gamma Knife SRS treatment plan for this patient is shown in figure 1. Gamma Knife SRS was delivered in a single fraction. The treatment was tolerated well, and the patient was discharged the next day.

Results

Seventeen months after treatment, the patient's quality of life is significantly improved. The patient's pain is well controlled and medication doses were decreased to infrequent use of analgesics. The patient's pain level now scores II on the BNI pain intensity scale.

A control MRI scan showed slight contrast enhancement in the trigeminal nerve shot area (figure 2), visualizing accurate irradiation of the target. No acute or late adverse radiation effects (ARE) were observed.

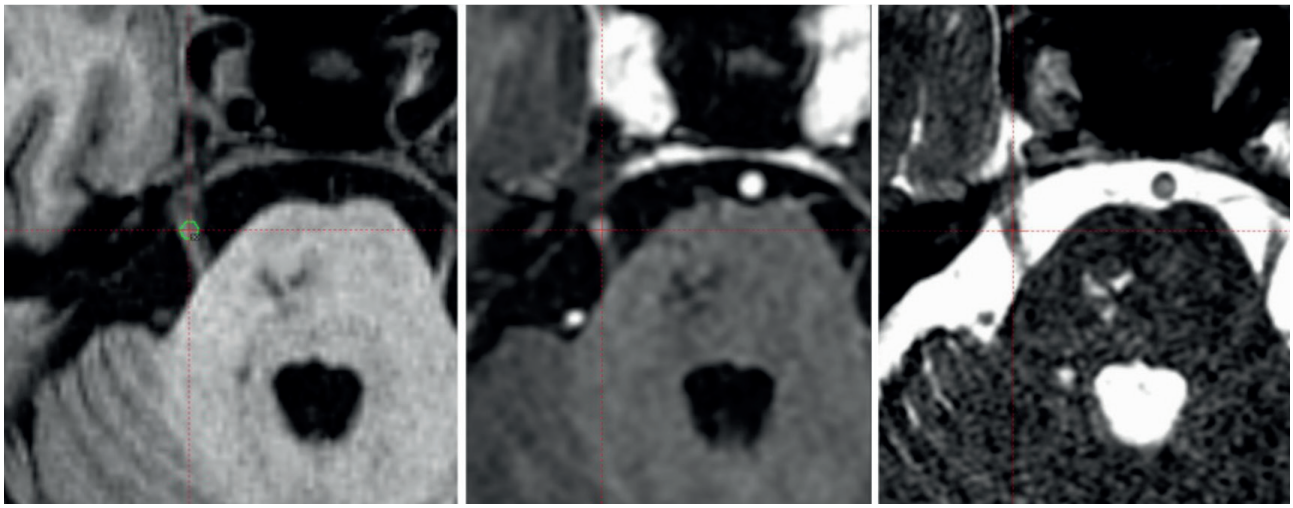

Figure 2.

MRI control 17 months after treatment: (Left) treatment plan; (Center) T1 MP-RAGE with contrast enhancement in shot area after 17 months; (Right) 3D T2-Cube 17 months after treatment.

Conclusions

TN pain alleviation using conservative treatment was not sufficient for this multiple sclerosis patient. Gamma Knife radiosurgery provided an effective, non-invasive means for us to achieve excellent results, reducing facial pain significantly from a score of IV to II on the BNI pain intensity scale. This minimized the patient's dependency on conservative treatments and allowed his reintegration into society.

Gamma Knife radiosurgery is less invasive compared to other surgical procedures, providing favorable pain control and a lower risk of complications for multiple sclerosis-associated TN patients.

Variations of trigeminal nerve length and its proximity to the brain stem require extreme treatment accuracy. The high accuracy and precision of Gamma Knife radiosurgery, combined with its excellent dose fall off, provides a safe and effective treatment for TN patients. The non-invasive nature of this treatment method means that it is less risk-associated for patients with severe comorbidities. In addition, its ability to spare healthy brain and critical structures allows patients to be retreated with SRS following a sufficient period of good pain control.

Gamma Knife radiosurgery for trigeminal neuralgia is a clinically proven treatment method with over 88,700 patients treated worldwide*.

*Leksell Gamma Knife Society

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