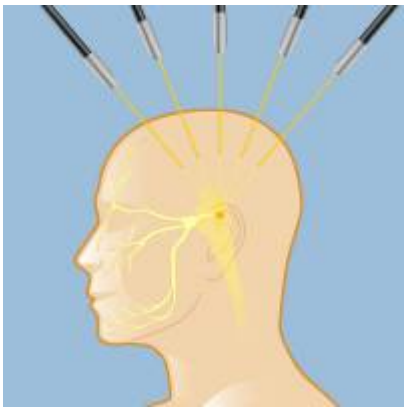
Gamma Knife radiosurgery for trigeminal neuralgia



Gamma knife radiosurgery (GKRS) is one of the alternatives for treatment for classical trigeminal neuralgia (TN).

The first use of SRS by Lars Leksell was for the treatment of trigeminal neuralgia. Initially, this was reserved for refractory cases following multiple operations [1].

The Leksell Gamma Knife and the Accuray CyberKnife systems have been used in the radiosurgical treatment of trigeminal neuralgia. The 2 techniques use different delivery methods and different treatment parameters. In the past, CyberKnife treatments have been associated with an increased incidence of treatment-related complications, such as facial numbness.

CyberKnife radiosurgical parameters can be optimized to mimic the dose distribution of Gamma Knife plans. However, Gamma Knife plans result in superior sparing of critical structures (brainstem, temporal lobe,and cranial nerves VII and VIII) and in steeper dose fall off away from the target. The clinical significance of these effects is unknown [2].

Indications

Generally recommended for patients with co-morbidities, high-risk medical illness, pain refractory to prior surgical procedures, or those on anticoagulants (anticoagulation does not have to be reversed to have SRS).

Mechanism

see Gamma Knife radiosurgery for trigeminal neuralgia mechanism

Treatment plan

4 -5 mm isocenter in the trigeminal nerve root entry zone identified on MRI. Use 70–80 Gy at the

center, keeping the 80% isodose curve outside of the brainstem.

Results: Significant pain reduction after initial SRS: 80–96% [3) 4) 5) 6)] but only ≈ 65% become pain free. Median latency to pain relief: 3 months (range: 1 d-13 months) [7)].

Recurrent pain occurs with in three years in 10–25%. Patients with TN and multiple sclerosis are less likely to respond to SRS than those without MS. SRS can be repeated, but only after four months following the original procedure.

Outcome

see Gamma Knife Radiosurgery for trigeminal neuralgia outcome.

Gamma Knife radiosurgery for recurrent trigeminal neuralgia

Gamma Knife radiosurgery for recurrent trigeminal neuralgia.

Case series

A total of 263 patients contributed by 9 member tertiary referral Gamma Knife centers (2 in Canada and 7 in USA) of the International Gamma Knife Research Consortium (IGKRF) constituted this study.

The median latency period of Facial pain response (PR) after SRS was 1 mo. Reasonable pain control (Barrow Neurological Institute Pain Scale I-IIIb) was achieved in 232 patients (88.2%). The median maintenance period from SRS was 14.1 months (range, 10 days to 10 years). The actuarial reasonable pain control maintenance rates at 1 yr, 2 yr, and 4 yr were 54%, 35%, and 24%, respectively. There was a correlation between the status of achieving BNI-I and the maintenance of facial pain recurrence-free rate. The median recurrence-free rate was 36 mo and 12.2 mo in patients achieving BNI-I and BNI > I, respectively (P = .046). Among 210 patients with known status of post-SRS complications, the new-onset of facial numbness (BNI-I or II) after SRS occurred in 21 patients (10%).

In this largest series SRS offers a reasonable benefit to risk profile for patients who have exhausted medical management. More favorable initial response to SRS may predict a long-lasting pain control [8)].

2016

One hundred seventeen patients with medically refractory TN treated by GKRS at the Department of Functional Neurosurgery and Gamma Knife Radiosurgery, and Department of Neurology, Ruber International Hospital, Madrid, Spain were followed up between 1993 and 2011. Mean maximum dose was 86.5 Gy (range: 80-90 Gy; median: 90 Gy). Clinical response was defined based on the Burchiel classification. They considered classes I and II as a complete response. For toxicity, they use the

Barrow Neurological Institute Pain Scale. Mean duration of follow-up was 66 months (range: 24-171 months).

Complete response at last follow-up in our patients was 81%, with an excellent response while off medication in 52%. Pain-free rates without medication (class I) were 85% at 3 years (confidence interval [CI]: 78%-94%), 81% at 5 years (CI: 72%-91%), and 76% at 7 years (CI: 65%-90%). Complete response rates (classes I-II) were 91% at 3 years (CI: 86%-97%), 86% at 5 years (CI: 79%-93%), and 82% at 7 years (CI: 72%-93%). Poor treatment response rates differed significantly between patients who had undergone previous surgery and were refractory to management with medication prior to GKRS. New or worsening facial numbness was reported in 32.5% (30% score II and 2.5% score III). No anesthesia dolorosa was reported. Permanent recurrence pain rate was 12%.

GKRS achieved favorable outcomes compared with surgery in terms of pain relief and complication rates in our cohort of patients, notwithstanding decreasing pain-free survival rates over time. They consider GKRS to be an initial treatment in the management of medically intractable TN in selected patients [9].

In a single-center, retrospective comparative study, 202 patients with MS and concomitant TN were evaluated. A minimum follow-up of 24 months was required. Patients with a history of microvascular decompression or previous intervention were excluded. There were 78 PBC procedures performed and 124 first-dosage GKRS procedures for a total of 202 patients between February 2009 and December 2013. The PBC procedures were successfully completed in all cases. The two groups were compared with regards to initial effect, duration of effect, and rate of complication(s), including the type and severity of the complication(s).

Immediate pain relief resulted in 87% of patients treated with PBC and in 23% of patients treated with GKRS. The Kaplan-Meier plots for the two treatment modalities were similar. The 50% recurrence rate was at 12 months for the PBC and 18 months for the GKRS. The rates of complication (excluding numbness) were 3% for GKRS and 21% for PBC. The difference was statistically significant (Chi-square test, $p = 0.03$).

PBC and GKRS are effective techniques for the treatment of TN in patients with MS, with GKRS presenting fewer complications and superior long-term relief. For these reasons, we consider GKRS as the first option for the treatment of TN in MS patients, reserving PBC for patients with acute, intractable pain [10].

Case reports

A 72-year-old -female presented with trigeminal neuralgia (TN) and radiological evidence of neurovascular compression on the affected side. She had complete resolution of her pain for 7 years after treatment with GKRS. The patient experienced recurrence and underwent repeat GKRS, this time resulting in another 3 years of pain relief. After the second recurrence, repeat intracranial imaging demonstrated resolution of neurovascular compression.

GKRS is an important treatment option for TN, although the mechanisms behind pain relief from this procedure still remain unclear. While prior histological and radiological studies point to ablative mechanisms for pain relief, this case report suggests that GKRS may result in a decompressive effect in TN due to changes in neurovascular architecture. Despite this finding, TN is known to occur and

recur in the absence of neurovascular compression; thus, further work is necessary to understand the etiology of TN and its treatments.

In this case, Moosa et al. demonstrated that vessel-nerve relationships may change over time in TN patients treated with GKRS, which raises the possibility that GKRS could release a neurovascular compression [11)].

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