STEREOTACTIC RADIOSURGERY FOR THE TREATMENT OF TRIGEMINAL NEURALGIA

Clinical White Paper

Trigeminal neuralgia (TN) is well defined and one of the most common causes of facial pain, especially in the elderly. It usually occurs as one-sided, severe, brief, recurrent episodes of spontaneous or stimulation-triggered facial pain in the territory of one or more branches of the trigeminal nerve[1,2].

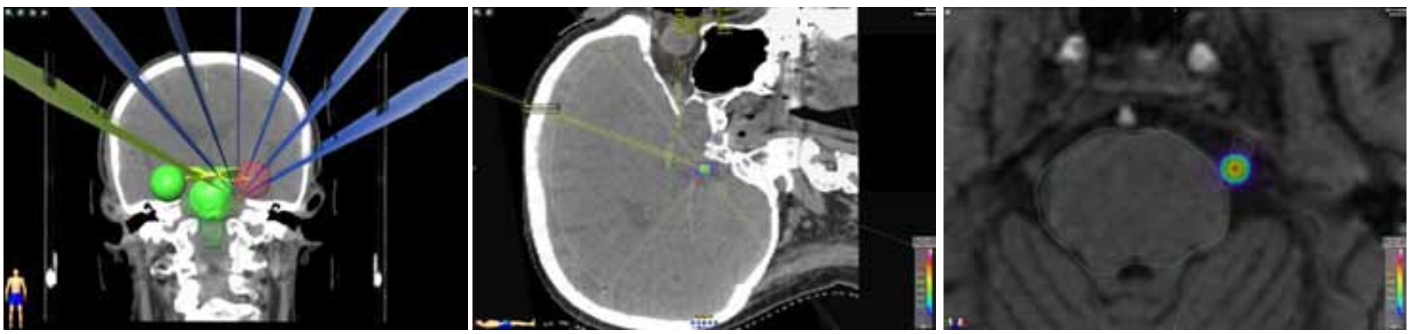

Figure: Details of a typical trigeminal neuralgia treatment plan

Nearly 80 to 90% of all TN cases are caused by a neurovascular conflict involving the trigeminal nerve and an artery. Another widely accepted cause of TN is mechanical compression of the trigeminal nerve root, usually within a few millimeters of entry into the pons—the root entry zone (REZ)[3]. However, much remains unclear about the exact pathology that induces TN, leading to discussions on precise treatment target options.

TN has been recognized as a unique neurological entity since antiquity[4]. Despite attempts throughout history, no ideal therapeutic option has emerged[5].

Traditionally treated by invasive surgical techniques, intracranial surgery was soon regarded a too aggressive treatment of TN[6]. Nowadays, medical therapies with various classes of pain medications, including anticonvulsants, are the choice for initial management of trigeminal pain.

However, about 25% of the patients do not respond to pain medications[7]. Among those who respond to pain medication, many patients develop intolerance to medication due to significant side effects[8].

When medications fail, minimally invasive approaches including percutaneous radiofrequency rhizotomy[9], glycerol injection[10], balloon compression[11], invasive craniotomy with microvascular decompression (MVD)[12] and stereotactic radiosurgery (SRS) are treatment options to control trigeminal pain. Among these available techniques, SRS has emerged as the least-invasive procedure, resulting in a significant pain relief with minimal side effects[13-18].

For one of the first applications of SRS, Dr. Lars Leksell delivered a focused dose of radiation to the trigeminal ganglion in a successful effort to treat TN[19]. The patients experienced long-lasting pain relief.

Since then, imaging and treatment modalities have evolved rapidly and dedicated linear accelerators (Linacs) have been developed and successfully used to treat TN[20]. An overview of some recent results for the SRS treatment of TN is presented in the table below.

Most authors reporting on SRS for TN treatments define the isocenter position based on the isodose line (IDL) touching the pons surface to limit the radiation dose delivered to this structure. In general, better pain relief is reported with higher doses to the trigeminal REZ, although more sensory compromise should be expected[5].

Therefore, some authors position the isocenter further from the pons on the cysternal portion of the trigeminal nerve (CTN)[21]. By targeting the nerve itself, they avoid delivery of a high radiation dose to the pons. However, a recent study demonstrated a significant correlation between pain relief and post-treatment enhancement of the pons, suggesting the importance of radiation delivery to the brainstem[22].

For the SRS treatment of TN, a typical dose of 70 to 90 Gy is delivered by five to seven circular arcs, with the 27 to 45 Gy IDL touching the pons. The conical collimators used for this treatment have diameters ranging from 4 to 7.5 mm, dependent on the location of the isocenter. For conical collimators with a diameter larger than 8 mm, the dose falloff deems its use risky for the treatment of TN[23].

Based on the recent literature—see the table below—SRS for TN has emerged as the safest procedure, leading to complete pain relief without medications or more than 50% pain relief with decreased medications for more than 70% of patients.

However, it should be noted that the overall likelihood of achieving a pain-free outcome without medications is lower than it is for MVD. Following radiosurgery, up to 50% of patients can have recurrence of pain within 3 years.

This is in distinction to microvascular decompression where approximately 20% of patients may have recurrence within the first five years after a successful initial outcome[24].

With a low risk of facial sensation loss being the most common side effect of SRS[25], dedicated linear-accelerator radiosurgery can be considered as an effective treatment for both primary and recurrent trigeminal pain[15]. Moreover, it is the only treatment to recommend without hesitation to patients who are medically frail or have some contraindication to anesthesia.

Overview of the recent clinical literature on SRS for trigeminal neuralgia

Author	Institution	Year	# Patients	Dose (Gy)	% Success	% Relapse
Goss[18]	Los Angeles Medical Center, Los Angeles	2003	25	90	100 at 18 months	32 at 8 months
Smith[15]	David Geffen School of Medicine, Los Angeles	2003	41	70 - 90	87 at 23 months	25 at 7 months
Frighetto[13]	David Geffen School of Medicine, Los Angeles	2004	17	90	95 at 21 months	23 at 8 months
Chen[14]	Los Angeles Medical Center, Los Angeles	2004	32	85 - 90	78 at 8 months	N/A
Gorgulho[22]	David Geffen School of Medicine, Los Angeles	2006	37	70 - 90	67 at 13 months	10 at 7 months
Pusztaszeri[21]	Centre Hospitalier Universitaire Vaudois, Lausanne	2007	17	50 - 56	100 at 12 months	29 at 8 months
Chen[16]	Los Angeles Medical Center, Los Angeles	2008	82	85 - 90	85 at 18 months	19 at 18 months
Zahra[17]	Baylor College of Medicine, Houston	2009	20	80 - 90	95 at 14 months	N/A

The success rate is defined as the combined number of patients that experienced either complete pain relief without medications or more than 50% pain relief with decreased medications. This corresponds to a Barrow Neurological Institute (BNI) pain intensity score of III or higher.

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