The Center for Facial Pain at the Midwest Neuroscience Institute at Research Medical Center offers comprehensive care for the diagnosis and treatment of all types of facial pain, including trigeminal neuralgia.

Trigeminal Neuralgia (TN) is a distressing problem for both patients and their physicians and frequently requires a multidisciplinary approach in order to achieve adequate pain control.

Anticonvulsant medication is the first line of treatment for patients with trigeminal neuralgia (TN). Neurosurgical treatment is reserved for those patients who fail to respond to drugs or develop unacceptable medication side effects. Whereas open skull surgery for microvascular decompression (MVD) of the trigeminal nerve is the most effective procedure for TN, percutaneous needle procedures and radiosurgery can also provide relief from disabling pain in patients who are not candidates for open skull surgery due to multiple co-morbidities, or elect not to undergo a craniotomy procedure.

Gamma Knife® Radiosurgery

Gamma Knife® surgery (also called stereotactic radiosurgery) is a way of treating trigeminal neuralgia, and other neurosurgical diseases, without opening the skull, without general anesthesia, and without the need for overnight hospitalization. The Gamma Knife (GK) utilizes 201 sources of Cobalt60 radially distributed over a segment of a sphere, so that the emitted beams of gamma radiation intersect at the center of the sphere. The dose from an individual radiation source is insufficient to cause tissue damage as it passes through skin, bone, and brain on route to the target. However, a therapeutic dose of radiation is attained at the center point of the sphere (isocenter) where the 201 gamma beams converge with 0.1mm accuracy (figure 1).

Twenty-one patients with TN were treated worldwide with the GK in 1992. The number of patients treated has grown exponentially from one year to the next with over 35,000 patients treated worldwide to date. The Midwest Gamma Knife center was the first Gamma Knife facility in the five state region (MO, IA, NE, KS, OK) and is the only radiosurgery facility consistently treating TN, in greater metropolitan Kansas City. Almost 200 patients have been treated for TN at the Midwest Gamma Knife Center since beginning operation in October 1994.
### Treatment Procedure

On the day of treatment the stereotactic frame is applied utilizing a local anesthetic and brief moderate sedation (figure 2). A high resolution MRI scan of the brain is then obtained and the images are transferred to the Gamma Plan workstation. The trigeminal nerve is identified and a 4mm collimator is positioned over the nerve root entry zone so that the 50% isodose line just touches the edge of the brainstem (figure 3). When treatment planning is complete, the X, Y, and Z coordinates of the target are obtained and the images are transferred to the Gamma Plan workstation. The trigeminal nerve is identified and numbness (dose range 70-90Gy) is the optimal dose that maximizes the chances for pain relief with an acceptable rate of facial numbness and paresthesias. We believe that a Dmax of 85 Gray over left trigeminal nerve positioned 4mm collimator over left trigeminal nerve.

**Figure 3:** Collimator set and the head frame is suspended in the collimator complete, the X, Y, and Z coordinates of the target are set and the head frame is suspended in the collimator helmet (figure 4) in preparation for treatment. Only a small minority of patients experience minor headache after treatment and patients may return home on the day of the procedure after a short period of observation. Restrictions on activities after Gamma Knife radiosurgery are not necessary and patients may resume pre-admission activities without delay. Since the average time to response after GK is about 4 weeks, we recommend that patients continue to take their TN medication until symptoms begin to abate. We suggest percutaneous balloon compression (PBC) or MVD for patients who require more immediate relief from severe, incapacitating and/or unrelenting pain.

**Figure 4:** Patient secured in collimator helmet awaiting treatment

### Dose Selection

A higher dose of radiation is more likely to provide pain relief but is also more likely to result in delayed side effects including uncomfortable facial numbness and paresthesias. We believe that a Dmax of 85 Gray (dose range 70-90Gy) is the optimal dose that maximizes the chances for pain relief with an acceptable rate of uncomfortable post treatment facial numbness.

### Patient Outcome Results

Although the treatment is completed in a single session, most patients report a decrease in frequency and severity of pain within six weeks. Patients with atypical pain features (continuous aching pain or dysesthetic pain) and patients with multiple sclerosis are less likely to achieve good pain relief following GK, as is the case for any neurosurgical intervention for TN. Kondziolka et. al. published a landmark review in April 2010 of 503 patients who were followed for up to sixteen years after treatment (107 patients with >5 year f/u). About 70% of patients reported significant pain relief (no pain, occasional pain not requiring medication or some pain adequately controlled with medication) at one year after treatment and almost 40% of patients were pain free without medication at one year after treatment. Treatment efficacy gradually decreases overtime with 46% of patients reporting significant pain relief at five years and 30% at ten years. Factors associated with earlier pain recurrence include atypical pain features and three or more prior failed surgical procedures. About 10% developed new or increased facial numbness, which correlated with improved long-term outcome. 2,3 Gamma Knife surgery can be repeated in patients with relapsing symptoms. We use a lower dose for a second treatment and may position the isocenter in a slightly more distal location on the nerve. There is an increased risk for post treatment paresthesias following multiple procedures.

### The Midwest Gamma Knife Center Experience

Questionnaires were mailed to 94 patients treated between 1/2003 and 1/2012. We were able to obtain forty-eight complete responses. Nine patients had multiple sclerosis and 20 patients had prior surgical procedures (8 pts had three or more procedures). 87% of patients without MS and 78% of patients with MS had significant pain relief at last follow up. Four out of nine patients with MS and eight out of 36 patients without MS required additional treatment after GK. Sixty-five percent (22/34) of patients reported new numbness after GK (4 somewhat bothersome and 1 very bothersome). 79% of patients agreed that they would have made the same decision to have GK treatment, 15% said they would have chosen not to and 6% were undecided.

Gamma Knife Radiosurgery is a safe and effective treatment for Trigeminal Neuralgia patients who have failed medical management and is of value for either initial or recurrent pain management.

### References