Trigeminal neuralgia (tic douloureux) is the most common facial pain syndrome, diagnosed in approximately 15,000 new patients each year in the US. Although this condition can be secondary to tumors or multiple sclerosis, it is believed that the majority of patients experience TN due to vascular compression and focal demyelination of the trigeminal nerve root. Medical therapy eliminates or significantly reduces the pain for approximately 75% of patients and is considered the treatment of choice for new-onset TN.

Unfortunately, the relief provided by medical therapy generally diminishes over time. A variety of operations have been used to treat patients with medically unresponsive TN, including PFE and SRS. The decision concerning which surgery to perform is based on a variety of factors, including the patient’s age, medical conditions, and the pain’s severity. Generally, MVD is considered to be the best operation for medically fit patients with TN. Less invasive procedures are commonly performed in patients with TN if they are elderly, suffer from significant medical comorbidities, or have recurrent facial pain after previous surgery. More recently, patient preference has emerged as an important deciding factor, and a large number of patients choose SRS as the least invasive procedure for TN based on information obtained from the Internet. To determine whether this is the best choice, in this study I have compared the relative effectiveness of PFE and SRS for patients with previously nonsurgically treated idiopathic TN.

**Comparison of posterior fossa exploration and stereotactic radiosurgery in patients with previously nonsurgically treated idiopathic trigeminal neuralgia**

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Object. Stereotactic radiosurgery (SRS) is commonly performed in patients with trigeminal neuralgia, and numerous investigators have found that facial pain outcomes after this procedure are better for patients in whom prior surgery did not fail. Researchers in some centers claim that the results of SRS are equivalent to posterior fossa exploration (PFE). The goal in this study was to verify that claim.

Methods. Information was retrieved from a prospectively maintained database of patients less than 70 years old with idiopathic trigeminal neuralgia who underwent PFE (55 patients) or SRS (28 patients) as their initial surgery between 1999 and 2004. Of the two groups, patients who underwent radiosurgery were older (60.5 compared with 50.7 years; p < 0.001). Microvascular decompression was performed in 49 patients (89%) and partial nerve section was performed in six (11%) in the PFE group. The mean maximum dose for SRS was 89.1 Gy. At a mean follow-up duration of 25.5 months, patients who had undergone PFE were more commonly pain free without medications (75% at 1 year, 72% at 3 years) compared with the patients treated with SRS (59% at 1 and 3 years; p = 0.01). Additional surgery was performed in 10 patients (18%) after PFE, compared with eight patients (29%) after SRS (p = 0.4). Eight patients (15%) had either new facial numbness (six cases) or dysesthesias (two cases) after PFE, whereas 12 (43%) had either new facial numbness (eight cases) or dysesthesias (four cases) after SRS. No correlation was noted between the development of facial numbness and facial pain outcome after PFE (p = 0.37), whereas patients in whom trigeminal dysfunction developed after radiosurgery were more frequently free of pain (p = 0.02).

Conclusions. The results support PFE as a more effective primary surgery than SRS in patients with idiopathic trigeminal neuralgia. Moreover, injury to the trigeminal nerve during PFE is not required to achieve excellent facial pain outcomes.

**KEY WORDS**

- trigeminal neuralgia
- microvascular decompression
- stereotactic radiosurgery
PFE (112, 33%), percutaneous retrogasserian glycerol rhizotomy (107, 31%), and balloon microcompression (two, 1%). Adult patients less than 70 years old in whom I performed primary surgery for idiopathic TN between July 1999 and March 2004 were eligible for enrollment in this study. Every patient had persistent pain despite medical therapy, and each one suffered episodic shocklike pain within the trigeminal distribution. Patients were informed that PFE was the surgery most likely to relieve their pain without causing facial numbness. Despite this information, 28 patients opted for SRS, whereas 55 underwent PFE; the patient characteristics are outlined in Table 1. Patients who underwent SRS were older than the ones in the PFE group (60.5 compared with 50.7 years, p < 0.001). The groups were otherwise similar with regard to sex, pain duration, pain location, and presence of constant pain.

Specific operative details for the two procedures are as previously described.20–22 During PFE, the superior cerebellar artery compressed the trigeminal nerve alone or in conjunction with other vessels in 44 cases (80%), the anterior inferior cerebellar artery in two cases (4%), and the basilar artery in one case (2%). Venous compression was noted in four cases (7%). In six patients (11%), partial nerve section was performed either alone (four cases) or in conjunction with MVD (two cases). Of note, three (38%) of eight patients with some degree of constant facial pain underwent partial nerve section compared with three (6%) of 47 patients who described no constant face pain before surgery (p = 0.03). The mean hospital duration of stay was 3.1 days. Stereotactic radiosurgery was performed using the Gamma Knife unit (Elekta Instruments, Norcross, GA). All patients were treated with a single 4-mm isocenter of radiation directed at the root entry zone. The mean maximum radiation dose delivered to the trigeminal nerve was 89.1 Gy (range 85–97.9 Gy; doses corrected to an output factor of 0.87 Gy). All patients who underwent SRS were discharged on the day of the procedure.

Preoperative, surgical, and postoperative follow-up information was entered into a prospectively maintained database. Patients were contacted 3 months postsurgery, and then yearly thereafter to assess their facial pain outcome. Facial pain outcomes were classified as excellent (absence of lancinating facial pain without medications for TN), good (complete pain relief but still requiring a low dose of medications), fair (continued facial pain but reduced > 50% compared with before surgery), and poor. Patient follow-up data were censored at last contact (65 patients), time of subsequent surgery (17), or death (one). The mean follow-up duration was 25.5 months.

Kaplan–Meier curves were calculated to determine the percentage of patients achieving and maintaining an excellent facial pain outcome after surgery.12 Differences in facial pain outcomes between the surgical groups were tested by log-rank methods. Univariate comparisons of continuous variables were compared using the Student t-test; proportional differences were compared by the Fisher exact test.

RESULTS

Initial pain results after PFE were excellent in 49 patients (89%), and good, fair, and poor in two patients each (4%). In 12 patients (22%) recurrent pain developed at a median interval of 3 months postsurgery. At the last follow-up visit, 39 patients (71%) were pain free without medications. Excellent facial pain outcomes were achieved and maintained in 75 and 72% of patients at 1- and 3-year intervals, respectively, after PFE.

Initial pain results after SRS were excellent in 16 patients (57%), good in five (18%), fair in three (11%), and poor in four (14%). Three patients (11%) had pain recurrence at a median of 4 months postsurgery. At the last follow-up visit, 15 patients (54%) were free of pain without medications. Excellent facial pain outcomes were achieved and maintained in 59% of patients at 1- and 3-year intervals after SRS. These results show that patients who underwent PFE were more likely to achieve and maintain an excellent facial pain outcome compared with the stereotactically treated group (p = 0.01; Fig. 1). There was no significant difference in the number of patients who underwent additional surgery after PFE (10 patients) and SRS (eight) (18% compared with 29%, p = 0.4).

Complications after PFE included cerebrospinal fluid leakage that required repair (two patients), wound infection (one), and symptomatic transverse sinus thrombosis requir-

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**TABLE 1**
Characteristics of 83 patients who underwent treatment for idiopathic trigeminal neuralgia*

<table>
<thead>
<tr>
<th>Factor</th>
<th>PFE (%)</th>
<th>SRS (%)</th>
<th>p Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of patients</td>
<td>55</td>
<td>28</td>
<td></td>
</tr>
<tr>
<td>M/F</td>
<td>21/34</td>
<td>12/16</td>
<td>0.81</td>
</tr>
<tr>
<td>mean age (yrs)</td>
<td>50.7</td>
<td>60.5</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>pain duration (yrs)</td>
<td>4.8</td>
<td>6.7</td>
<td>0.11</td>
</tr>
<tr>
<td>rt/lt</td>
<td>34/22</td>
<td>14/14</td>
<td>0.48</td>
</tr>
<tr>
<td>pain location</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>single division</td>
<td>20 (36)</td>
<td>13 (46)</td>
<td>0.48</td>
</tr>
<tr>
<td>multiple divisions</td>
<td>35 (64)</td>
<td>15 (54)</td>
<td></td>
</tr>
<tr>
<td>any V1 facial numbness</td>
<td>17 (31)</td>
<td>5 (18)</td>
<td>0.29</td>
</tr>
<tr>
<td>any V1 pain</td>
<td>4 (7)</td>
<td>3 (11)</td>
<td>0.68</td>
</tr>
<tr>
<td>constant pain</td>
<td>8 (15)</td>
<td>3 (11)</td>
<td>0.74</td>
</tr>
</tbody>
</table>

* V1 = first division of the trigeminal nerve.
The majority (89%) of patients in whom a PFE was performed underwent MVD. This procedure is nondestructive and removes the neurovascular compression believed to be the origin of facial pain for the majority of patients with TN. Unlike ablative techniques, pain relief after MVD is independent of postoperative facial sensory disturbances. Moreover, the pain relief after MVD has also been determined to be quite durable. In the large series by Barker, et al., on 1185 patients, 70% of patients were free of pain without medications for TN 10 years postoperatively. Likewise, Tronnier, et al., found excellent outcomes in 65% of patients 10 years after MVD. Thus, if the goals of TN surgery are elimination of facial pain without medications and preservation of trigeminal function, then MVD is the best available operation.

Nevertheless, in some patients no neurovascular compression is found at surgery. The ability to perform a partial nerve section provides another means to provide pain relief, but most patients will experience a degree of facial numbness if the nerve is cut or intentionally manipulated. The obvious drawback of PFE is the potential risk associated with this operation. Nonetheless, the chance of major morbidity or death after PFE is low. In my series, only one patient (2%) suffered a new neurological deficit other than facial numbness.

Despite these considerations, PFE may not be the best operation for all patients. Negative predictive factors after MVD include female sex, long pain duration, prior MVD, and atypical pain features. Of note, in this series 15% of the patients who underwent a PFE described a component of constant facial pain in addition to intermittent shocklike pains. A neurovascular conflict was frequently not detected at surgery in patients with constant facial pain, and these individuals more frequently underwent a partial nerve section rather than an MVD. Although it is likely that these patients have Type 2 TN based on Burchiel’s recent facial pain classification scheme, I avoided using this terminology because it would disrupt the prospective nature of the TN patient database.

Importantly, age has not been correlated with worse outcomes after MVD for TN. Investigators in several papers have concluded that outcomes for MVD in patients older than 65 years were similar to those in younger patients, with no increase in the risk of serious morbidity or death. Thus, MVD appears to be safe and effective even for older patients with TN if their general medical condition is stable and the aim of treatment is complete pain relief without medications. Finally, PFE is predicted to be a more cost-effective option than SRS, despite higher procedural costs, because of its increased efficacy and the less frequent need for later surgeries. At our center, the cost of a quality-adjusted pain-free year after PFE was $8174 compared with $8269 for SRS.

**DISCUSSION**

The goal of surgery for TN is to eliminate the patient’s facial pain with minimal morbidity. In this series, PFE provided a significantly higher cure rate than SRS in patients with previously nonsurgically treated idiopathic TN. This is noteworthy because the patients in the radiosurgery group would be predicted to do better than those in published reports on radiosurgery for TN (Table 2) for several reasons. First, patients in this comparison had not undergone prior surgeries for their facial pain. In several reports investigators have shown that patients who experience recurrent pain after their initial surgeries have worse results after SRS than patients who have not undergone prior surgical treatment. Conversely, the mean radiation dose used over this time frame was rather high (89.1 Gy). At radiation doses below 80 Gy, the chance of remaining pain free without medications 3 years after SRS is 40% or less. Conversely, at radiation doses above 85 Gy, approximately 55 to 60% of patients are pain free without medications 3 years after treatment. Most centers, however, have gradually reduced the radiation dose to minimize the chance of bothersome facial numbness after SRS. Therefore, the results of this study contradict the claim by some radiosurgery centers that SRS provides equivalent facial pain outcomes compared with PFE and should be considered the primary surgical option for patients with medically unresponsive TN.

### TABLE 2

**Literature review of reported outcomes after radiosurgery for trigeminal neuralgia**

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>No. of Patients</th>
<th>Radiation Dose (Gy)</th>
<th>% Pain Free</th>
<th>% w/ Facial Numbness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maesawa, et al., 2001</td>
<td>220</td>
<td>80</td>
<td>57 at 3 yrs (off meds)</td>
<td>10 at 2 yrs</td>
</tr>
<tr>
<td>Pollock, et al., 2002</td>
<td>117</td>
<td>87</td>
<td>55 at 3 yrs (off meds)</td>
<td>37 (crude)</td>
</tr>
<tr>
<td>Smith, et al., 2003 (LINAC)</td>
<td>41</td>
<td>90</td>
<td>45 at 3 yrs (off meds)</td>
<td>25 (crude)</td>
</tr>
<tr>
<td>Massager, et al., 2004</td>
<td>47</td>
<td>90</td>
<td>59 at 3 yrs (off meds)</td>
<td>38 (crude)</td>
</tr>
<tr>
<td>Brisman, 2004</td>
<td>293</td>
<td>76.8</td>
<td>10 at 3 yrs (off meds)</td>
<td>NS</td>
</tr>
</tbody>
</table>

* LINAC = linear accelerator; meds = medications; NS = not stated.

**References**


5. Brismar R: Gamma knife surgery with a dose of 75 to 76.8 Gray for trigeminal neuralgia. J Neurosurg 100:848–854, 2004


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