

## Facial Pain: Comparison of Treatments advanced level

### Overview

Several disorders that cause facial pain can be successfully treated by neurosurgical procedures. It is important to accurately diagnose the disorder and identify the best treatment for each disorder. In the absence of randomized prospective studies, methods of reporting, and outcome criteria, it is difficult to compare the results of various surgical procedures and the different reported series of the same surgical procedure. Nevertheless, several important observations emerge from reviews of the literature and personal experience.

### General Observations on Facial Pain

1. Accurate diagnosis is required.
2. The diagnosis of typical Trigeminal Neuralgia (TGN) is seldom difficult.
3. In general, the length of the list of the patient's symptoms is directly proportional to the likelihood of treatment failure.
4. Medical treatment should be explored before surgery is contemplated.
5. There is no successful surgical procedure for treatment of atypical facial pain.
6. It is more difficult to treat neuropathic than neuralgic pain.
7. Patients with dysesthetic pain seldom respond to ablative surgery.
8. There is no single superior treatment for facial pain. The treatment should be individualized. Patients should have access to a broad spectrum of treatment options.
9. The results of surgical treatment diminish as facial pain becomes more chronic.

### These observations can serve as general guidelines for treatment of:

1. Trigeminal Neuralgia (TGN)
2. Recurrent Trigeminal Neuralgia
3. Facial Pain with Multiple Sclerosis and Tumors
4. Trigeminal Neuropathic Pain
5. Vaguglossopharyngeal Neuralgia
6. Cluster Headache

### 1. Results for Trigeminal Neuralgia (TGN)

Generalizations regarding treatment of TGN have been presented in the literature. While some surgeons advocate one procedure for all patients, others select different surgical procedures for different patients. In the midst of this controversy, surgeons must not lose sight of the facts and observations pertaining to the treatment of TGN. Following are some of our observations:

#### Recognize atypical TGN and status trigeminus

One must distinguish atypical TGN from atypical facial pain. In atypical TGN, patients report lancinating or brief episodes of sharp or burning pain that last seconds to minutes and are associated with milder constant aching pain.

Some patients experience status or continuous repeated episodes of pain of TGN. These patients appear fatigued, often dehydrated, and in constant severe pain. They frequently report simple continuous pain rather than the typical episodic pain. Such patients usually require an urgent surgical procedure.

#### There is no current cure for TGN

All current surgical procedures for TGN are associated with risk of pain recurrence (1). After successful surgery, pain of TGN can progress to involve other trigeminal nerve divisions or the contralateral side. In some patients, pain of TGN is difficult to treat, regardless of what treatment is given. Longstanding chronic TGN is more difficult to treat. Long-term pain relief is highest after microvascular decompression (MVD) and percutaneous stereotactic radiofrequency rhizotomy (PSR).

Figure 1. TGN Pain Recurrence

Procedure	Follow-up	Pain-free
MVD	7 years	77%
PSR	6 years	75%
Glycerol rhizotomy	3 years	55%
Balloon compression	3 years	76%
Radiosurgery	1.5 years	55%

Among the current treatment options, microvascular decompression (MVD) and percutaneous stereotactic radiofrequency (PSR) rhizotomy have comparable rates of pain relief that are highest among the available options. In a review of series of approximately 100 patients or more published in the past 10 years (2-12), the rates of pain relief calculated were 77% in 7 years for MVD and 75% in 6 years for PSR rhizotomy.

The timing of pain recurrence is similar for MVD and PSR. In the series of Barker et al. (6), pain recurrence occurred primarily in the first 2 years after MVD, and then dropped to 2% per year in years 3-5, 1% per year in years 6-10, and 0.7% per year thereafter. In the authors series (13), pain recurrence after PSR rhizotomy occurred in 3% of patients per year through the first 5 years, 1.4% per year in years 6-10, and 0.75% thereafter.

Glycerol rhizotomy and radiosurgery have the highest rates of pain persistence or recurrence. Pain relief calculated 55% in 3 years for glycerol rhizotomy (2,14-21). Initial results of 129 patients from three series demonstrate a pain relief rate of 55% in 1.5 years after radiosurgery (22-24). Balloon compression has a recurrence rate that is higher than that of MVD and PSR rhizotomy, but lower than that of glycerol rhizotomy and radiosurgery. Pain relief was calculated to be 75% in 3 years for balloon compression (2,25,26).

**All percutaneous procedures are associated with dysesthesia**

Glycerol rhizotomy is frequently reported to be the preferred percutaneous destructive procedure because of its rare association with dysesthesia (troublesome numbness). Our review of the literature does not support this hypothesis. In a review of the results of 1751 patients in 10 series, significant dysesthesias occurred in 4% of patients after glycerol rhizotomy, in 7% of patients after PSR rhizotomy, and in 6% of patients after balloon compression. Some surgeons relate the high incidence of dysesthesia to poor technique, such as the injection of glycerol without cisternography or injection of large volumes of glycerol during glycerol rhizotomy (21), production of anesthesia and analgesia during PSR rhizotomy (1), and prolonged balloon inflation during balloon compression (26). Supporters of glycerol rhizotomy and balloon compression estimate a lower incidence of dysesthesia in technically adequate procedures (21). Supporters of PSR rhizotomy estimate rates of dysesthesia and pain recurrence that are comparable with those of glycerol rhizotomy and balloon compression if lesions created by PSR produced hypalgesia only (1).

Contrary to percutaneous destructive procedures, MVD rarely produces significant facial numbness or dysesthesia. In the authors experience, facial sensory loss and dysesthesia complicated cases of venous compression or excessive manipulation of

the trigeminal rootlets. The initial results of radiosurgery demonstrate a rare association with sensory loss and dysesthesia, despite the fact that the nerve is deliberately injured (23).

Among the percutaneous destructive procedures, **PSR rhizotomy** has the highest risk of postoperative loss of corneal sensations after surgery for V-1 pain. PSR rhizotomy differentially affects the small myelinated and unmyelinated fibers, which mediate the corneal reflex (2). In contrast, balloon compression differentially affects large myelinated fibers (26). Glycerol has neurolytic effects on both small and large myelinated fibers (21). In our review of the literature, the corneal reflex was lost in 6% of PSR rhizotomies, in 5% of glycerol rhizotomies, and in 1% of balloon compressions. MVD and radiosurgery have been rarely associated with corneal anesthesia.

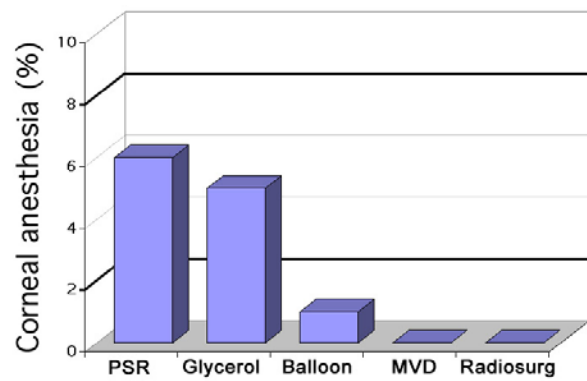


Figure 2. Postoperative corneal anesthesia in patients with V-1 pain is highest after PSR rhizotomy

**Balloon compression** carries the highest risk of postoperative trigeminal motor weakness. In a review of the literature, trigeminal weakness occurred transiently in 19% of patients after PSR rhizotomy, infrequently (1%) after glycerol rhizotomy, and permanently in 5% after balloon compression. Trigeminal motor weakness occurred rarely after MVD and radiosurgery. Complications such as trismus, otalgia, and hyperacusis have not been thoroughly discussed in the literature and are likely underestimated.

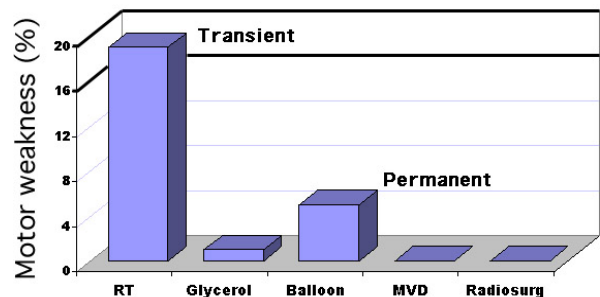


Figure 3. Postoperative trigeminal motor weakness is highest after balloon compression

Literature review demonstrates that the **perioperative mortality** or serious morbidity (i.e., stroke, hemorrhage, venous sinus occlusion, myocardial infarction, hydrocephalus), permanent hearing loss or facial palsy, and minor perioperative complications (i.e., wound dehiscence or infection, cerebrospinal fluid leak, pseudomeningocele, bacterial and aseptic meningitis, pulmonary complications, ataxia) were higher after MVD than after percutaneous procedures. After MVD, serious morbidity or mortality occurred in 1%, permanent hearing loss occurred in 3%, and minor complications occurred in 16%. The risks are higher in patients who have an ectatic and tortuous vertebrobasilar system arterial tree (27). These results do not compare favorably with rates of 0.07% serious morbidity and mortality, 0.5% serious hearing loss, and 1.3% minor complications for percutaneous procedures.

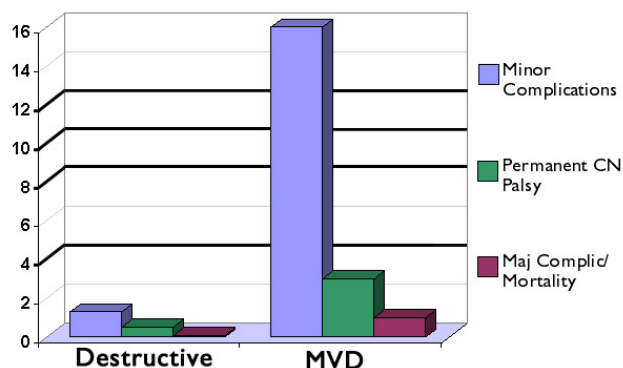


Figure 4. Perioperative morbidity and mortality are higher after MVD than after percutaneous destructive procedure.

### Conclusion

MVD is highly successful in treating pain of TGN with a relatively low risk of pain recurrence, dysesthesia, corneal analgesia, and trigeminal motor weakness; however, one should not overlook the perioperative risks associated with this surgery,

especially in the elderly. MVD may be best suited for healthy patients, but is not the best procedure for patients in poor medical condition. Because of the risk of hearing loss, MVD may not be suitable for patients who have contralateral hearing loss. MVD may also not be the best procedure for patients who have large, ectatic, and tortuous vertebrobasilar arterial system because of increased perioperative morbidity.

Percutaneous destructive procedures are appropriate procedures for the elderly and for those in poor medical condition. Because of its low pain recurrence rate, PSR rhizotomy generally seems to be the most appropriate procedure. By avoiding dense lesions, adverse effects of dysesthesias are greatly reduced. PSR rhizotomy may not be the best procedure for patients with V-1 pain and patients with pain distributed over the three trigeminal divisions.

Because glycerol rhizotomy is associated with a high recurrence rate, the procedure likely requires repetition. Multiple glycerol injections are associated with a higher risk of failure and adverse effects. During glycerol rhizotomy, surgeons and patients should be ready to convert the procedure to PSR rhizotomy if cerebrospinal fluid flow is not obtained. Because of its low risk of trigeminal motor dysfunction, glycerol rhizotomy is particularly advantageous for patients with contralateral pain, trigeminal motor weakness, and temporomandibular joint dysfunction. Glycerol rhizotomy is also appropriate for patients who have pain over V-1 or the entire face and are not candidates for a posterior fossa procedure.

Balloon compression seems particularly advantageous for patients who have V-1 pain and are not good candidates for microvascular decompression. Alternative procedures for these patients include glycerol rhizotomy, peripheral nerve section, and radiosurgery.

Other surgical procedures have a role in the treatment of TGN. Peripheral nerve section is appropriate for elderly patients with V-1 pain or with bilateral facial pain. Radiosurgery has a role in the treatment of patients who cannot safely undergo surgical procedures, such as patients who are receiving anticoagulants.

In summary, the authors conclude that the discipline of treating TGN should be similar to disciplines of treating other disorders, such as aneurysms, tumors, and vascular malformations. The discipline entails a multimodality approach conducted by a team who can offer medical and surgical treatments directed to the needs of the individual patient.

All available procedures for TGN have side-effects (+=lowest, +++=highest)						
Surgery	Pain Recurrence	Dysesthesia (numbness)	Motor weakness	Corneal anesthesia	Minor morbidity	Major morbidity
MVD	+	+	+	+	+++	+++
PSR	+	+++	+	+++	+	+
Glycerol Rhizotomy	+++	++	+	+	+	+
Balloon Compression	++	+++	+++	+	+	+
Rhizotomy	+	+++	+	+++	+++	+++
Neurectomy	++	+++	+	+	+	+
Radiosurgery	+++	+	+	+	+	+

## 2. Results for Recurrent Trigeminal Neuralgia

Controversy exists regarding the treatment of persistent or recurrent TGN. All procedures that currently treat initial TGN can effectively treat recurrent pain. To help select the best treatment, the authors review the following facts and observations:

### **TGN frequently recurs in other trigeminal divisions**

TGN frequently recurs in trigeminal divisions previously free of pain. This observation, which can follow all surgical procedures, may represent progression of the underlying disorder rather than recurrence.

### **Repeat MVD is frequently unsuccessful**

A second MVD is performed in less than one-third of all posterior fossa explorations for pain recurring after a prior MVD; therefore, most patients undergoing a second posterior fossa surgery require or undergo trigeminal rhizotomy (28-30). Repeat MVD is associated with increased risk of cranial nerve palsy, perioperative morbidity, and dysesthesia (28-30). In the series of Barker et al., the risk of disturbing facial numbness increased to 8% after repeat MVD (6). In our experience, better results can be achieved by using percutaneous techniques (1). In less than 1% of cases, patients with intractable TGN require complete section of the sensory and motor root to achieve pain relief.

### **Repeat glycerol rhizotomy is frequently unsuccessful**

Repeat glycerol rhizotomy is associated with a higher risk of technical failure because the trigeminal cistern becomes less accessible after repeated glycerol injections (21,31). There is no documentation that PSR rhizotomy and balloon compression are associated with greater technical failure when these procedures repeated. All percutaneous procedures do have a higher risk of sensory complications following repeated procedures.

### **Percutaneous destructive procedures are not indicated in patients with analgesia**

All percutaneous destructive procedures fail to relieve recurrent trigeminal pain in patients who are analgesic in the painful division. Such patients may require posterior fossa exploration for MVD or intracranial trigeminal rhizotomy, radiosurgery, dorsal root entry zone (DREZ) surgery, or motor cortex stimulation.

### **Conclusion**

Posterior fossa exploration for recurrent trigeminal pain following MVD is not suitable to the majority of patients because of a low success rate. Superior

results can be achieved by percutaneous destructive procedures, especially PSR rhizotomy, with less risk of perioperative complications. Otherwise healthy patients with pain recurring after a prior percutaneous destructive procedure are best treated by MVD. A repeat percutaneous procedure or radiosurgery is considered for patients who are medically unhealthy. Patients who have recurrent TGN in an analgesic area rarely benefit from repeat destructive surgery, but may be relieved by decompression or complete section of the sensory and motor root.

## 3. Results for Facial Pain with Multiple Sclerosis and Tumors

### **Trigeminal Neuralgia Associated with Multiple Sclerosis**

Trigeminal neuralgia associated with multiple sclerosis (TGN-MS) is difficult to alleviate due to multiple factors. Following are some facts and observations:

#### **MVD fails to treat TGN-MS**

Even the strongest advocates of MVD do not recommend this surgery for TGN-MS because of its high failure rate (32).

#### **Percutaneous destructive procedures can effectively treat TGN-MS, although a higher recurrence rate is anticipated**

All percutaneous destructive procedures have successfully relieved pain of TGN-MS, but with a higher recurrence rate than primary TGN. This is especially true for glycerol rhizotomy (21,33). Denser levels of hypalgesia are needed to control pain of TGN-MS than in primary TGN.

#### **TGN-MS frequently involves multiple divisions or occurs bilaterally**

TGN-MS may recur in different trigeminal divisions or on the contralateral side of the face. Therefore, it is appropriate to recommend a destructive procedure, such as PSR rhizotomy, which is most selective in achieving hypalgesia.

### **Conclusion**

Patients with TGN-MS are more difficult to treat. There is no role for MVD in such patients. PSR rhizotomy seems to be the most appropriate treatment for this condition because it is the most selective destructive procedure in tailoring the quantity and location of sensory deficit. The initial results of radiosurgery for TGN-MS have not been encouraging, with less than 50% of patients achieving acceptable pain control. Other techniques, such as motor cortex stimulation and percutaneous trigeminal nucleotomy-tractotomy, deserve investigation for multiple recurrent pain.

## **Symptomatic Trigeminal Neuralgia Associated with Tumor**

Although reports document that patients with TGN who harbor tumors, aneurysms, vascular malformations, or cysts (TGN-MASS) are young, have sensory deficits, and experience more atypical pain, the authors have observed patients with symptomatic lesions who have typical TGN. Similar observations have led others to advocate performing imaging studies on all patients with TGN (34).

TGN-MASS can be effectively treated by tumor excision and MVD when vascular compression is found (34,35). In the series of Barker et al., pain relief was achieved in 81% of patients in 10 years following that approach (36). PSR rhizotomy has achieved similar results in patients who are not candidates for elective surgical removal of the lesion (34,37). Initial results of radiosurgery indicate a high rate of pain relief following radiation of tumors (23). Anecdotal data indicate that pain relief may follow embolization of arteriovenous malformations and clipping of aneurysms (36). The literature contains insufficient information to allow the comparison of the different techniques in treatment of TGN-MASS.

### **Conclusion**

In TGN-MASS, the authors recommend directing the treatment to the intracranial mass. Percutaneous destructive procedures can effectively control pain if surgery or radiosurgery to the tumor is not otherwise indicated.

## **4. Results for Trigeminal Neuropathic Pain**

Patients who experience pain distributed in the trigeminal nerve may have the typical symptoms of TGN. The following concepts and observations should be remembered in assessing and treating these patients:

### **Recognize patients with neuroma**

Patients who experience facial pain after trauma or facial surgery may harbor a neuroma. These patients usually describe constant, dull, and burning pain along the distribution of a branch of the trigeminal nerve. A Tinel's sign and temporary relief with a lidocaine block can establish the diagnosis. These patients can improve after peripheral neurectomy.

### **Treatment of patients with dysesthesia**

Dysesthesia (troublesome numbness) that develops after percutaneous destructive procedures is usually mild and temporary. There is no good treatment for patients with persistent dysesthesia. Destructive procedures are not recommended because they

usually worsen the symptoms. MVD has generally not been successful. Techniques such as trigeminal stimulation, motor cortex stimulation, caudalis DREZ surgery, and PSR nucleotomy-tractotomy require further evaluation.

## **5. Results for Vagotossopharyngeal Neuralgia**

Current neurosurgical procedures for the treatment of vagotossopharyngeal neuralgia include PSR rhizotomy, open intracranial rhizotomy, MVD, and recently PSR trigeminal nucleotomy-tractotomy. In recommending treatment, one must consider the following observations:

### **Open intracranial rhizotomy has the highest rate of long-term pain relief**

After open rhizotomy of the glossopharyngeal and upper vagal rootlets, long-term pain relief is consistently achieved in more than 90% of patients (38,39). MVD has inconsistently achieved high rates of pain relief. Some surgeons reported pain relief in more than 90% of patients after MVD (40,41), Resnick et al. reported a 76% pain relief in patients followed for more than 2 years (42).

### **PSR rhizotomy carries the highest risk of postoperative dysphagia, vocal cord paralysis, and irritative cough**

The authors have had difficulty achieving precise controlled coagulation of the glossopharyngeal and vagal nerves. Many series have reported dysphagia and vocal cord paralysis after PSR rhizotomy (38). The authors restrict the use of PSR rhizotomy to patients with glossopharyngeal neuralgia from cancer who already have developed vocal cord paralysis and swallowing difficulty.

Open rhizotomy has been associated with 10-20% risk of temporary swallowing problems (38). Many authors have decreased this risk by restricting vagal rhizotomy to the upper two or upper third of the vagal rootlets and preserving the upper large-diameter vagal rootlets (38). The authors have not encountered cases of postoperative permanent dysphagia or vocal cord paralysis after they used intraoperative monitoring of the false vocal cord to differentiate motor from sensory vagal rootlets (43).

MVD was introduced to minimize the risks associated with section of the upper vagal rootlets; however, dysphagia and vocal cord paralysis can develop from excessive manipulation of the lower cranial nerves. In the series of Resnick et al., 10% of patients developed transient paresis of the cranial nerves IX and X and 2% developed permanent moderate swallowing difficulty (42).

### **Perioperative care**

Patients with glossopharyngeal neuralgia may develop hemodynamic instability during intubation, manipulation of the lower cranial nerves, and postoperatively secondary to hypersensitivity to the vagus nucleus, ephaptic transmission between cranial nerves IX and X or nuclei, and hypersensitivity of the carotid sinus reflex. Before laryngeal intubation, topical anesthesia to the oropharynx and intravenous atropine should be administered. Intraoperatively, the surgeon should avoid excessive manipulation of the lower cranial nerves to decrease risks of severe fluctuations of blood pressure and heart rate. Atropine should be administered prior to section of the vagal rootlets. Strict postoperative control of blood pressure is required to avoid hypertensive crisis. These risks should be taken seriously. In the series of Resnick et al. of MVD, the mortality rate from hemodynamic instability was 5% (42).

### **Open rhizotomy is recommended for patients with vagoglossopharyngeal syncope**

Ten percent of patients with vagoglossopharyngeal neuralgia develop sudden excessive vagal outflow during an attack resulting in bradycardia, heart arrhythmias, hypotension, syncope, seizure, or cardiac arrest, known as vagoglossopharyngeal syncope. Bradyarrhythmia can be transiently blocked by atropine, while hypotension usually responds to local injection of lidocaine near the carotid bifurcation (38). Vagoglossopharyngeal syncope can be successfully treated with carbamazepine and with open rhizotomy (38). Data are insufficient to support the use of MVD or other surgical procedures for this disorder.

Open rhizotomy is contraindicated in bilateral glossopharyngeal neuralgia. In the rare event of bilateral glossopharyngeal neuralgia, open rhizotomy carries a high risk of swallowing problems from sectioning both glossopharyngeal nerves (38). In bilateral glossopharyngeal neuralgia, MVD is likely the treatment of choice.

### **Conclusion**

Open rhizotomy seems to have the highest rate of long-term pain relief. Risks of postoperative dysphagia and vocal cord paralysis are minimized by using intraoperative vagal monitoring. MVD has a low risk of permanent dysphagia and vocal cord paralysis and a lower rate of long-term pain relief. Open rhizotomy is the treatment of choice for patients who experience vagoglossopharyngeal syncope. MVD is the treatment of choice for patients who develop bilateral glossopharyngeal syncope. PSR rhizotomy should be restricted to patients with pain of cancer who already have swallowing problems and vocal cord paralysis. Percutaneous trigeminal nucleotomy-tractotomy requires further evaluation before recommending it as a treatment option (44).

## **6. Results for Cluster Headache**

The surgical treatment of chronic cluster headache is difficult, but worthy of consideration after an appropriate medical therapy has been explored. Two systems are implicated in the pathogenesis of cluster headache: the trigeminovascular system and the nervus intermedius-superficial petrosal-sphenopalatine system. Surgery directed to one or both of these systems include percutaneous destructive procedures (PSR trigeminal rhizotomy, glycerol rhizotomy, balloon compression), open trigeminal rhizotomy, MVD of the trigeminal root, superficial petrosal neurectomy, section of the nervus intermedius, MVD of the nervus intermedius, and caudalis DREZ surgery. The authors review the following facts and observations:

### **Surgery of either system can be successful**

In combined series (38,45-48), long-term pain control was achieved in 62% of 210 patients who underwent surgery of the trigeminovascular system (Table 7) and in 54% of 203 patients who underwent surgery of the nervus intermedius-superficial petrosal-sphenopalatine system (Table 8). Results of small series of surgery on both systems suggest rates of pain control approximating 80% (38). Regardless of the surgery that is performed, good pain control rather than complete pain relief is expected.

### **Glycerol rhizotomy and MVD are the least effective procedures for the trigeminovascular system**

In a review of combined series, long-term pain control was achieved in 62% patients who underwent PSR trigeminal rhizotomy, in 68% of patients who underwent open trigeminal rhizotomy, and in only 33% of patients who underwent glycerol rhizotomy. Glycerol rhizotomy is not recommended for the treatment of cluster headache by some authorities (21). Limited experience with isolated MVD of the trigeminal rootlets has been disappointing (38).

In patients with cluster headache who undergo PSR rhizotomy, pain is best controlled when a dense sensory lesion is made in the V-1 and V-2 regions (38). Experience with glycerol rhizotomy has been similar (38). Patients who undergo open trigeminal rhizotomy require section of the rostral part of the nerve for good pain control (38,45). Major sensory loss is associated with increased risks of keratitis and dysesthesia that can be up to 12% (38). For this reason, balloon compression may be worthy of consideration for the treatment of cluster headache; however, results have not been reported.

### **Surgeries to the nervus intermedius-superficial petrosal-sphenopalatine system seem equally effective**

In combined series, long-term pain control was achieved in 54% of patients who underwent superficial petrosal neurectomy, in 50% of patients who underwent section of the nervus intermedius, and in 56% of patients who underwent percutaneous PSR sphenopalatine gangliolysis. Limited experience with isolated MVD of the nervus intermedius has been disappointing (38).

### **Cluster headache is occasionally associated with intracranial pathology**

There are anecdotal reports of patients with chronic cluster headache who achieve pain relief following surgery for tentorial meningiomas, pituitary tumors, arteriovenous malformations, and aneurysms (38). These patients most likely experience referred pain along the ophthalmic or maxillary divisions that can mimic pain of chronic cluster headache.

### **Innovative treatments**

There may be a role for newer surgical approaches for cluster headache. Initial results of radiosurgery have been encouraging, with pain controlled in 6 of 8 patients followed for 8-14 months (49). Recently, ultrasonic trigeminal nucleotomy-tractotomy has achieved pain control in 11 of 12 patients (46). The authors, however, are aware of several patients who underwent caudalis DREZ surgery with only transient pain relief.

### **Conclusion**

In cluster headache, pain can be controlled by surgery to either the trigeminal system or nervus intermedius-superficial petrosal-sphenopalatine system. With both approaches, the pain is rarely cured. In the author's experience, periorbital pain is best relieved by PSR trigeminal rhizotomy or open intracranial rhizotomy with section of the nervus intermedius if pain radiates to the temple-ear region. To avoid sensory loss, surgeons may combine MVD with section of the nervus intermedius with less successful results. Other approaches, such as balloon compression, radiosurgery, and trigeminal nucleotomy-tractotomy require further investigation.

### **Sources**

Through the Trigeminal Neuralgia Association (TNA), local support groups are available. The support group provides an opportunity for patients and their families to share experiences, receive support, and learn about advances in treatments, pain control, and medications. Additional information is available on the web at [www.tna-support.org](http://www.tna-support.org) or [facial-neuralgia.org](http://facial-neuralgia.org)

If you would like information about the Greater Cincinnati Trigeminal Neuralgia Support Group, please call the Mayfield Clinic at (513)569-5290.

For support outside Greater Cincinnati, please contact the Trigeminal Neuralgia Association at (609)361-1014.

### **Sources/Bibliography**

The following journal articles and books formed the basis of our observations along with our own personal experience.

1. Taha JM, Tew JM Jr. Comparison of surgical treatments for trigeminal neuralgia: Reevaluation of radiofrequency rhizotomy. *Neurosurgery* 1996; 38:865-871.
2. Tew JM Jr, Taha JM. Percutaneous rhizotomy in the treatment of intractable facial pain (trigeminal, glossopharyngeal, and vagal nerves). In: Schmidek HH, Sweet WH, eds. *Operative neurosurgical techniques*. 3rd ed. Philadelphia: W.B. Saunders, 1995:1469-1484.
3. Sindou M, Amrani F, Mertens P. Microsurgical vascular decompression in trigeminal neuralgia. Comparison of 2 technical modalities and physiopathologic deductions. A study of 120 cases. *Neurochirurgie* 1990; 36:16-25.
4. Cutbush K, Atkinson R. Treatment of trigeminal neuralgia by posterior fossa microvascular decompression. *Aust N Z J Surg* 1994; 64:173-176.
5. Mendoza N, Illingworth R. Trigeminal neuralgia treated by microvascular decompression: A long-term follow-up study. *Br J Neurosurg* 1995; 9:13-19.
6. Barker F, Jannetta P, Bissonette D, Larkins M, Jho HD. The long-term outcome of microvascular decompression for trigeminal neuralgia. *N Engl J Med* 1996; 334(17):1077-1083.
7. Kondo A. Follow-up results of microvascular decompression in trigeminal neuralgia and hemifacial spasm. *Neurosurgery* 1997; 40:46-51.
8. Lee KH, Chang JW, Park YG, et al. Microvascular decompression and percutaneous rhizotomy in trigeminal neuralgia. *Stereotact Funct Neurosurg* 1997; 68:196-199.
9. Pagura J, Rabello J, De Lima W. Microvascular decompression for trigeminal neuralgia. In: Gildenberg P, Tasker R, eds. *Textbook of stereotactic and functional neurosurgery*. New York: McGraw-Hill, 1996:1715-1721.
10. Miserocchi M, Cabrini G, Motti E, et al. Percutaneous selective thermorhizotomy in the treatment of essential trigeminal neuralgia. *J Neurosurg Sci* 1989; 33:179-183.
11. Ischia S, Luzzani A, Polati E, et al. Percutaneous controlled thermocoagulation in the treatment of trigeminal neuralgia. *Clin J Pain* 1990; 6:96-104.
12. Zakrzewska J, Thomas D. Patient's assessment of outcome after three surgical procedures in the management of trigeminal neuralgia. *Acta Neurochir (Wien)* 1993; 122:225-230.
13. Taha JM, Tew JM Jr. A prospective 15-year follow up of 154 consecutive patients with trigeminal neuralgia treated by percutaneous stereotactic radiofrequency thermal rhizotomy. *J Neurosurg* 1995; 83:989-993.
14. Waltz T, Dalessio D, Copeland B, et al. Percutaneous injection of glycerol for the treatment of trigeminal neuralgia. *Clin J Pain* 1989; 5:195-198.
15. Ischia S, Luzzani A, Polati E. Retrogasserian glycerol injection: A retrospective study of 112 patients. *Clin J Pain* 1990; 6:291-296.
16. De La Porte C, Verlooy J, Veeck G, et al. Consequences and complications of glycerol injection in the cavum of Meckel: A series of 120 consecutive injections. *Stereotact Funct Neurosurg* 1990; 54-55:73-75.
17. Steiger H. Prognostic factors in the treatment of trigeminal neuralgia. Analysis of a differential therapeutic approach. *Acta Neurochir (Wien)* 1991; 113:11-17.
18. Cappabianca P, Spaziante R, Graziussi G, et al. Percutaneous retrogasserian glycerol rhizolysis for treatment of trigeminal neuralgia. Technique and results in 191 patients. *J Neurosurg Sci* 1995; 39:37-45.

19. Bergenheim A, Hariz M, Laitinen L, Olivecrona M, Rabow L. Relation between sensory disturbance and outcome after retrogasserian glycerol rhizotomy. *Acta Neurochir (Wien)* 1991;111:114-118.
20. Jho HD, Lunsford D: Percutaneous retrogasserian glycerol rhizotomy. *Neurosurg Clin North Am* 1997;8(1):63-74.
21. Hakanson S, Linderöth B. Injection of glycerol into the gasserian cistern for treatment of trigeminal neuralgia. In: Gildenberg P, Tasker R, eds. *Textbook of stereotactic and functional neurosurgery*. New York: McGraw-Hill, 1998:1697-1706.
22. Kondziolka D, Lunsford D, Habek M, Flickinger J. Gamma knife radiosurgery for trigeminal neuralgia. *Neurosurg Clin North Am* 1997;8(1):79-85.
23. Young R, Vermeulen S, Grimm P, Blasko J, Posewitz A. Gamma knife radiosurgery for treatment of trigeminal neuralgia: Idiopathic and tumor related. *Neurology* 1997;48:608-614.
24. Rand R. Leksell gamma knife treatment of tic douloureux. *Neurosurg Clin North Am* 1997;8(1):75-78.
25. Addenabi B, Mahfouf L, Nedjahi T. Long-term results of percutaneous compression of the gasserian ganglion in trigeminal neuralgia. *Stereotact Funct Neurosurg* 1997;68:190-195.
26. Brown J, Gouda J. Percutaneous balloon compression of the trigeminal nerve. *Neurosurg Clin North Am* 1997;8(1):53-62.
27. Linskey M, Jho HD, Jannetta P. Microvascular decompression for trigeminal neuralgia caused by vertebrasilar compression. *J Neurosurg* 1994;81:1-9.
28. Cho DY, Chang C, Wang YC, et al. Repeat operations in failed microvascular decompression for trigeminal neuralgia. *Neurosurgery* 1994;35:665-670.
29. Yamaki T, Hashi K, Niwa J, et al. Results of reoperation for failed microvascular decompression. *Acta Neurochir (Wien)* 1992;115(1-2):1-7.
30. Rath S, Klein H, Richter H. Findings and long-term results of subsequent operations after failed microvascular decompression for trigeminal neuralgia. *Neurosurgery* 1996;39:933-938.
31. Rappaport Z, Gomori J: Recurrent trigeminal cistern glycerol injections for tic douloureux. *Acta Neurochir (Wien)* 1988;90(1-2):31-34.
32. Resnick D, Jannetta P, Lunsford D, et al. Microvascular decompression for trigeminal neuralgia in patients with multiple sclerosis. *Surg Neurol* 1996;46:358-361.
33. Kondziolka D, Lunsford L, Bissonette D. Long-term results after glycerol rhizotomy for multiple sclerosis-related trigeminal neuralgia. *Can J Neurol Sci* 1994;21:137-140.
34. Puca A, Meglio M. Typical trigeminal neuralgia associated with posterior cranial fossa tumors. *Ital J Neurol Sci* 1993;14:549-552.
35. Jamjoom A, Jamjoom Z, Al-Fehaily M, et al. Trigeminal neuralgia related to cerebellopontine angle tumors. *Neurosurg Rev* 1996;19:237-241.
36. Barker I, Peter J, Babu R, et al. Long-term outcome after operation for trigeminal neuralgia in patients with posterior fossa tumors. *J Neurosurg* 1996;84:818-825.
37. Cheng T, Cascino T, Onofrio B. Comprehensive study of diagnosis and treatment of trigeminal neuralgia secondary to tumors. *Neurology* 1993;43:2298-2302.
38. Taha JM, Tew JM Jr. Surgical management of glossopharyngeal and other uncommon facial neuralgias. In: Tindall G, Cooper P, Barrow D, eds. *The practice of neurosurgery*. Baltimore: Williams & Wilkins, 1996:3065-3080.
39. Taha JM, Tew JM Jr. Long-term results of surgical treatment of idiopathic neuralgias of the glossopharyngeal and vagal nerves. *Neurosurgery* 1995;36(5):926-931.
40. Sindou M, Henry J, Blanchard P. Idiopathic neuralgia of the glossopharyngeal nerve. Study of a series of 14 cases and review of the literature. *Neurochirurgie* 1991;37:18-25.
41. Wakiya K, Fukushima T, Miyazaki S. Results of microvascular decompression in 16 cases of glossopharyngeal neuralgia. *Neurol Med Chir (Tokyo)* 1989;29(12):1113-1118.
42. Resnick D, Jannetta P, Bissonnette D, et al. Microvascular decompression for glossopharyngeal neuralgia. *Neurosurgery* 1995;36:64-69.
43. Taha JM, Tew JM Jr, Keith R, et al. Intraoperative monitoring of the vagus nerve during intracranial glossopharyngeal and upper vagal rhizotomy. Technical note. *Neurosurgery* 1994;35:775-777.
44. Kanpolat Y, Savas A, Batay F, Sinav A. Computed tomography-guided trigeminal tractotomy-nucleotomy in the management of vagoglossopharyngeal and geniculate neuralgias. *Neurosurgery* 1998;43:484-490.
45. Kirkpatrick P, O'Brien M, MacCabe J. Trigeminal nerve section for chronic migrainous neuralgia. *Br J Neurosurg* 1993;7:483-490.
46. Grigorian IUA, Ogleznev KIA, Roshchina NA. Surgical treatment of migrainous neuralgia. *Zh Vopr Neirokhir im N N Burdenko* 1995;4:16-19.
47. Taha JM, Tew JM Jr. Long-term results of radiofrequency rhizotomy in the treatment of cluster headache. *Headache* 1995;35:193-196.
48. Sanders M, Zuurmond W. Efficacy of sphenopalatine ganglion blockade in 66 patients suffering from cluster headache: A 12- to 70-month follow-up evaluation. *J Neurosurg* 1997;87:876-880.
49. Ford R, Ford K, Swaid S, Jennelle R. Gamma knife treatment of refractory cluster headache. *Headache* 1998;38:3-9.

updated > 11.2001

originally published > Tew JM, Taha JM: Therapeutic Decisions in Facial Pain. *Clin Neurosurg* 46:410-431, 2000



This information is not intended to replace the medical advice of your doctor or health care provider. For more information about our editorial policies and disclaimer of liability visit [www.mayfieldclinic.com/policies.htm](http://www.mayfieldclinic.com/policies.htm), or write to attn: Tom Rosenberger, Mayfield Clinic & Spine Institute, 506 Oak Street, Cincinnati, OH 45219 513.221.1100 • 800.325.7787

© Mayfield Clinic 2002. All rights reserved.