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REVIEW ARTICLE

Trigeminal Neuralgia: The New Surgical Treatment Modalities

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ABSTRACT

Trigeminal Neuralgia is a painful condition of the oro-facial structures. The diagnostic criteria are based upon the patient's history, examination and clinical evaluation. In the course of the disease patients experience dull, aching, throbbing or burning, constant pain in the same distribution as the paroxysms. A long interval between the attacks is often described as a period of increasing paresthesias in the nerve distribution. The trigger stimulus, applied to the "trigger zone", often arouses intense pain in divisions beyond the one stimulated. Treatment involves the medicinal as well as surgical procedures. Medicinal therapy is usually first to start. With time patient became refractive to medicinal therapy. Under this condition, surgical treatment is recommended. This paper focus particularly on the surgical aspect of this painful condition.

Keywords: Trigeminal, Neuralgia, Pain, Surgical management.

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INTRODUCTION:

In the treasury of human experience, no emotion leaves as vivid an imprint on man's memory as one characterized by pain. A painful experience being one that is not only unforgettable, but also produces changes within that individual's psyche as regards future painful experiences. The alleviation of pain, therefore comprises one of the most important and satisfying duties of one engaged in the health services and particularly is true when one talks about pain as excruciating as trigeminal neuralgia (1).

John Fothergill gave the first full and accurate description of trigeminal neuralgia in 1773, but early descriptions of trigeminal neuralgia (Fothergill's disease) (2) can be inferred from the writings of Galen, Aretaeus of Cappadocia (born circa AD 81), and in the 11th century by Avicenna (''tortura oris'') (3).

There are many different opinions concerning trigeminal neuralgia etiology, however some of them are controversial and lack objective evidences. Currently, there are three most popular theories (4-6). These are as endogenous and exogenous intoxication (4), temporomandibular joint pathology (5) and high position of the petrous pyramid apex of the temporal bone 6). In reality, for most patients with TN, there is no identifiable cause.

The goal of any form of treatment for trigeminal neuralgia is long term relief of pain. While medications provide effective management for many trigeminal neuralgia patients, medical therapy is often not a permanent solution of this problem. Fortunately for trigeminal neuralgia patients, there are several surgical procedures available if medications no longer provide the desired results.

The purpose of this paper is to provide an overview of various clinical parameters of trigeminal neuralgia which have been developed for patient relief in dental practice. This paper particularly provides detail about surgical treatment aspect of trigeminal neuralgia which are attracting a high level of interest.

Surgical Management of Trigeminal Neuralgia

The surgical procedure is recommended for patients who continue to experience severe pain or side effects from medications. While considering a surgical technique one must consider many factors. There are some important neurosurgical procedures. Each is effective, but not always and occasionally has to be repeated. These are divided into extra-cranial (7) and intra-cranial procedures:

EXTRACRANIAL

- Peripheral nerve injections- Local anesthetic agents, alcohol.
- Peripheral Neurectomy.
- Cryosurgery.
- Stereotactic radiofrequency thermocoagulation at gasserion ganglion.
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INTRACRANIAL

- Radiofrequency thermocoagulation.
- Percutaneous retrogasserian rhizotomy with a. Glycerol injection, b. Alcohol injection.
- Nerve decompression- a. Microvascular decompression (MVD), b. Balloon microcompression (BMC).
- Medullary and Midbrain tractotomy

EXTRA-CRANIAL PROCEDURES

Peripheral nerve injections

Bartholow (in 1876) and Neuber (in 1883) were the first to promote the benefits of chemoneurolysis in the treatment of trigeminal neuralgia. Bartholow described the use of chloroform and Neuber of osmic acid; these materials were injected into the vicinity of the nerve trunks. Many investigators subsequently advocated peripheral alcohol injections in the treatment of trigeminal neuralgia, even though side effects included temporary weakness of the muscles of mastication, transient sensory loss, and/or paresthesia. The limitations of this treatment also included the expected eventual recurrence of trigeminal neuralgia as the nerve regenerated and sensation returned (8). This method includes injection with Local anaesthesia and with alcohol injections.

Peripheral neurectomy

Neurectomy is the oldest of all procedures. This procedure on various peripheral branches of the trigeminal nerve, such as supra-orbital, infraorbital, mental and inferior alveolar nerves has long been known to play a beneficial role in the management of trigeminal neuralgia. It gives pain relieve up to 33 months. These peripheral procedures are not commonly used presently, primarily because of high incidence of pain recurrence and complete sensory loss of the area supplied by that particular nerve. Peripheral neurectomy is easy to perform, well tolerated by elderly or debilitated, or cognitively impaired patients, and can often be performed while the patient is under local anesthesia (9,10).

Cryosurgery

In 1976, Lloyd et al. described the use of cryotherapy to eliminate pain in peripheral nerves. Good results were achieved with open nitrogen spray, so called spray-freezing the infraorbital nerve. However surgical exposure of the nerve is required and damage to the adjacent tissues is likely if the spray is inaccurately applied. A newer method of cryotherapy involves the use of a cryoprobe. The application of cold to tissues creates a conduction block, similar to the effect of local anesthetics. The effect of cryotherapy is that the cryolesion initially produces total blockage of large and small fibre input, thereby completely "closing the gate". Large fibres will regenerate in several weeks and patient will experience a gradual return of sensation. Small pain transmitting fibres do not recover. Thus cryotherapy acts by a process of selective nerve fibre destruction (11).
Stereotactic Radiosurgery Stereotactic radiosurgery treats brain disorders with a precise delivery of a single, high dose of radiation in a one day session. Focused radiation beams are delivered to a specific area of the brain to treat abnormalities, tumors or functional disorders. Stereotactic radiosurgery is limited to the head and neck, because these areas can be immobilized with skeletal fixation devices that completely restrict the head's movement, permitting the most precise and accurate treatment. Radiosurgery (one-session treatment) has such a dramatic effect in the target zone that the changes are considered "surgical". Through the use of three-dimensional computer-aided planning and the high degree of immobilization, the treatment can minimize the amount of radiation that passes through healthy brain tissue. Stereotactic radiosurgery is routinely used to treat brain tumors and lesions. It may be the primary treatment, used when a tumor is inaccessible by surgical means; or as a boost or adjunct to other treatments for a recurring or malignant tumor. In some cases, it may be inappropriate (12).

Gamma Knife Radio Surgery

Gamma Knife surgery is recognized worldwide as the preferred treatment for brain tumors, arterio-venous malformations and brain dysfunctions such as trigeminal neuralgia. Advantages of Gamma Knife includes (13) -Gamma Knife is a neurosurgical tool designed exclusively for the treatment of brain disorders, the lesion being treated receives a high dose of radiation with minimum risk to nearby tissue and structures, the cost of a Gamma Knife procedure is often 25% to 30% less than traditional neurosurgery and the patients experience little discomfort.

INTRACRANIAL PROCEDURES

Radiofrequency thermocoagulation

Percutaneous technique for the treatment of trigeminal neuralgia becomes more precise and safer with the use of new Electromagnetic Navigation Technology. Radiofrequency current plied to nerve tissue creates molecular friction, creating heat and finally caus-

ing a heat lesion.

More recently, Pulsed Radiofrequency (PRF), where high frequency current is applied in bursts of 20 milliseconds with pauses of 480 milliseconds allowing the heat to escape, consequently creates lesions at much lower temperature. Therefore this technique is much safer and causes fewer side effects such as numbness, dysesthesia, anaesthesia dolorosa, or even anaesthesia of the cornea (14).

GLYCEROL INJECTION

This method was introduced by Hakanson after a fortuitous discovery, during the development of a stereotactic technique for gamma radiation, that glycerol mixed with tantalum powder not only visualized trigeminal cistern but also abolished pain in patients with trigeminal neuralgia. Hartel (15) in 1912 pioneered the percutaneous transovale approach to the Gasserian Ganglion using absolute alcohol. Sweet (16,17) (1974) described glycerol injection (and radiofrequency) lesioning to the ganglion. Hakanson (18) (1981) accidentally discovered glycerol relieved tic pain when injecting the retrogasserian space. This method is generally well tolerated and mortality is negligible.

Alcohol injection at Gasserian Ganglion

High surgical risk patients suffering medically intractable trigeminal neuralgia are excellent candidates for percutaneuos procedures at the level of the fifth nerve; the Gasserian ganglion or its peripheral branches, which can not only relieve the pain, but also eliminate or decrease the obnoxious side effects of drugs used to treat it. Percutaneous neurolysis of the trigeminal nerve is an old procedure, usually guided with fluoroscopy and/or plain film radiographs, or computed tomography.

Microvascular Decompression

Microvascular decompression is the gold standard treatment for primary trigeminal neuralgia (19). Dandy (20) in 1934 suggested causal relationship between vascular cross compression and trigeminal neuralgia. Gardner and Miklos (21) in1959 positioned gel-foam between the artery and nerve. Jannetta 'popularised' the concepts of vascular compression and surgical treatment. Principle behind MVD is "Neurovascular Separation". The vital step for this operation is identification and separation of the offending vessels which can be artery, vein, or both, without traumatizing any other structure.

Balloon Micro Compression (BMC)

Balloon microcompression is a technique used to apply pressure to the trigeminal nerve to change the way it transmits pain. The trigeminal nerve carries sensation and pain fibres from the face to the brain. Balloon microcompression may be considered for the treatment of adults with trigeminal neuralgia for whom medical (and, where appropriate, psychosocial) management has failed. There is low quality evidence that balloon microcompression is effective for the treatment of adults with trigeminal neuralgia. This procedure is easy to perform requires a short anaesthetic, and a brief period of hospitalization. It is well tolerated by patients who describe it as a "totally pain free experience". Morbidity is minimal, and the recurrence rate is not significantly higher than other procedures for trigeminal neuralgia (22,23).

Medullary and midbrain tractotomy

In patients complaining of severe pain in the head and face, uncontrolled by other surgical procedures, the spinothalamic tract may be divided in the medulla or the midbrain. For the treatment of trigeminal neuralgia, Sjoquist described, in 1938, the method of cutting the spinal tract of the trigeminal nerve in the medulla. Walker devised, in 1942, a method of severing the spinothalamic tract in the midbrain (mesencephalic tractotomy). This resulted in analgesia and thermoanaesthesia of the opposite half of the body, but often the relief was incomplete was incomplete and short lasting and sequelae like ataxia and dysaesthesia frequently incapacitated the patient.

NEWER APPROACHES (19,24)

Even though current medical and surgical techniques are effective for many neurological problems, many of these approaches afford only partial or temporary control, and often the available techniques, such as central nervous system surgery, are too drastic to be applied to the numerous milder syndromes found in the maxillofacial region. The side effects of traditional therapies may be more troublesome than the original disease problems. For these reasons there is continuing search for new treatments of neurological disorders, especially for chronic, idiopathic pain conditions.

Physiologic inhibition of pain by transcutaneous neural stimulation (19)

The use of physiological counter stimulation to inhibit chronic pathological pain grew out of the gate control concept of pain threshold. Even peripheral nerve stimulations have shown promise by use of this technique. For example, low voltage radio frequency waves have been passed through the surface and needle electrodes that were implanted into the infraorbital, lingual, and auriculotemporal nerves of patients with idiopathic trigeminal neuralgia. The most widely used and effective stimulation approach, however, is transcutaneous neural stimulation. In this, cutaneous bipolar surface electrodes are placed in the painful body regions, and low-voltage electrical currents are administered by the patient. Best results have been obtained when intense stimulation is maintained for at least an hour daily for more than 3 weeks. Transcutaneous neural stimulation has proved most effective against neuropathic pain such as phantom limb pain and nerve injury pain. It has

been effective in a smaller percentage of patients with facial pain but, when successful, is an excellent non-invasive treatment.

Acupuncture

Serious consideration must now be given to acupuncture as a physiological para-psychological approach to pain control and neurological treatment. Acupuncture theory is based on an invisible system of communication between various organs of the body that is distinct from the circulatory, nervous, and endocrine systems known to Western medicine. As a surgical anesthetic technique, acupuncture has the advantage of convenience, great safety, stability of vital functions, no interruptions of patient hydration, no nausea or vomiting, and no postoperative respiratory complications. Pathological pains have also been controlled in cases of appendicitis, peptic ulcer, hepatic abscess, and renal biliary colic, and toothaches have been completely relieved by needling at the dorsum of the wrist (the "hoku" point). Patients apparently sense a "numbness, distension, heaviness and hotness" at specific sites in addition to a generalized raising of the thresholds of pain. Other remarkable physical effects include increased circulation time and transient leukocytosis. In experimental animals, profound shock has been reversed, and sleep EEG patterns have been induced by needling.

Psychological approaches

Significant control over pain and other sensory complaints may be gained through psychophysiological techniques such as relaxation therapy, bio-feedback, hypnosis, and psychotherapy. Many of the chronic, episodic pain syndromes such as myofascial pain dysfunction, vascular headaches, and atypical burning mucosa are known to be markedly influenced by the patient's response to stress and particularly to depression. The technique of progressive relaxation originally developed by Jacobson and the related techniques of autogenic biofeedback are now gaining wide acceptance as pain therapies. Biofeedback techniques have been especially useful for the pain of migraine and other vascular headaches in which the patient is trained to control cranial vascular dilation through a technique of hand temperature control.

CONCLUSION

Trigeminal neuralgia is a very troublesome disease. At present, many surgical procedures are available for the relief of drug-refractory trigeminal neuralgia. The ideal operation appears to be microvascular decompression, since it would appear to elucidate the cause(s) of essential trigeminal neuralgia for the majority of patients and, also, because it can abolish pain with little or no loss of facial sensation. Trigeminal neuralgia patients who are poor medical risks, those who are above the age of 65, those with demyelinating disease, and those who are unwilling to accept the increased risk of a posterior fossa craniectomy, should be treated with this percutaneous trigeminal ganglion compression procedure. If the procedure is unsuccessful or if the recurrence of symptoms that cannot be controlled medically develops, the trigeminal ganglion compression procedure would be an appropriate next step.

REFERENCES

1. Popovici F, Mergeani A, Popescu D, Antochi F. Review on the causes of trigeminal neuralgia symptomatic to other diseases. *Romanian Journal of Neurology* 2011;**10**(2):69-72.
2. Stookey B, Ranshoff J. Trigeminal Neuralgia: Its History and Treatment. Springfield, IL: Charles C Thomas, 1959:10.
3. Lotfi J, Chaemmaghami AB, Minagar A. Avicenna and his description of trigeminal neuralgia. *Neurology* 2000;**54**(Suppl 3):A176.
4. Bernat JL, Sullivan JK. Trigeminal neuralgia from digitalis intoxication. *JAMA* 1979;**241**(2):164.
5. Miller DB. The "missing link" in the origin of trigeminal neuralgia: a new theory and case report. *Funct Orthod* 1999;**16**(1):4-6, 8,10-13.
6. Smith DG, Mumford JM. Petrous angle and trigeminal neuralgia. *Pain* 1980;**8**(3):269-77.
7. Loh Hong-Sai. Surgical treatment of trigeminal neuralgia. *Journal of Oral Rehabilitation* 2004;**26**(7):613-17.
8. Cole CD, Liu JK, Apfelbaum RI. Historical perspectives on the diagnosis and treatment of trigeminal neuralgia. *Neurosurg Focus* 2005;**18**(5):1-10.
9. Quinn JH, Weil T. Trigeminal neuralgia: treatment by repetitive peripheral neurectomy, Supplemental report. *Journal of Oral Surgery* 1975;**33**(8):591-95.
10. Riaz Ahmad Warraich. Intractable Trigeminal Neuralgia: Comparison of neurectomy with cryosurgery as a treatment option. *The Professional* 2001;**8**(2);36-43.
11. Nally FF. A 22 year study of PTN in 211 patients with 3 year appraisal of the role of cryotherapy. *Oral Surg Oral Med Oral Pathol* 1984;**58**(1):17-23.
12. Douglas Kondziolka, L Dade Lunsford. Stereotactic radiosurgery for trigeminal neuralgia: a multi institutional study using the gamma unit. *J Neurosurg* 1996;**84**: 940-45.
13. Kondziolka D. Gamma knife radiosurgery for trigeminal neuralgia. *Arch Neurol* 1998;**55**:1524-29.
14. E Gerald, D Silverberg, Richard H Britt. Percutaneous Radio-Frequency Rhizotomy in the Treatment of Trigeminal Neuralgia. *West J Med* 1978;**129**:97-100.
15. Die Lietungsanasthesie und injektionsbehandlung des ganglion gasseri und der trigeminusstamme. *Arch Klin Chir* 1912:**100**;193-292.
16. Treatment of trigeminal neuralgia and other facial pains by retrogasserian injection of glycerol. *Neurosurgery* 1981;**9**: 647-53
17. Controlled thermocoagulation of trigeminal ganglion and rootlets for differential destruction of pain fibres. *J Neurosurg* 1974;**39**:143-56.
18. Trigeminal neuralgia treated by the injection of gylcerol into the trigeminal cistern. *Neurosurgery* 9;638-46.
19. Barker F, Jannetta P, Bissonette D. The long-term outcome of microvascular decompression for trigeminal neuralgia. *The New England Journal of Medicine* 1996;**334**:1077-83.
20. Dandy WE. Concerning the cause of trigeminal neuralgia. *Am J Surg* **24**;447-455.
21. Gardner, Miklos. Response of trigeminal neuralgia to decompression of sensory root. *Journal of American Medical Association* 170;1773-76.
22. Mruthunjaya B, Raju C. Trigeminal Neuralgia: a comparative evaluation of four treatment procedures. *Oral Surgery* 1981;**52**(2):126-32.
23. Haines JS, Chittan CJ. Which operation for trigeminal neuralgia. *Practical Neurology* 2003;**3**:30-35.
24. Textbook of Oral and Maxillofacial Surgery, 6th edition. The CV Mosby Company, USA, pg. 740-742.