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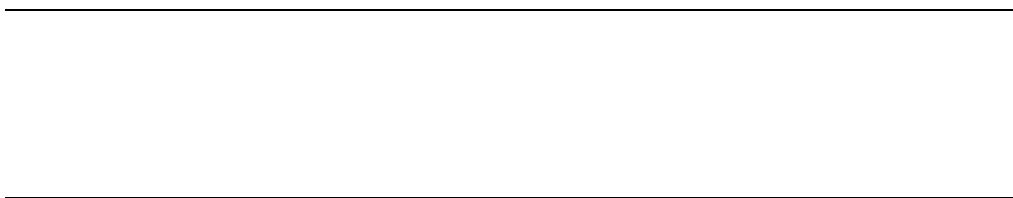
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## Chapter Thirteen

# MIGRAINE & PERIPHERAL NERVES



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***MIGRAINE HEADACHE!!!!!!.***

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## MIGRAINE & PHERIPERAL NERVES

### INTRODUCTION

#### ***MIGRAINE HEADACHE!!!!!***

You know what it is. That is not why you are reading this.

You have tried diets, given up chocolate and caffeine.

You know what you are allergic to and to what you are not allergic.

You have tried over-the-counter medicine and prescription medicines.

You live in a dark world... *Bright light is the enemy!*

You live in a quiet world.... *Loud sound is the enemy!*

You spend many days each month, sometimes each week....in bed.

You have lived, if this is living, like this for years, even decades.

**YOU HEARD THAT A NERVE MAY BE THE CAUSE,  
AND THAT NERVE SURGERY MAY BE THE ANSWER.  
THAT IS WHY YOU ARE READING THIS!**

***AND IT IS TRUE.***

***THERE IS HOPE FOR YOUR MIGRAINES  
WITH PERIPHERAL NERVE SURGERY.***

## DEFINITIONS



Figure 13-1A. The Scream. Edvard Munch, 1893.  
<http://ourjourneytosmile.com/blog/wp-content/uploads/2009/06/the-scream-edvard-munch.jpg>

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The word “migraine” is Greek for hemikranium”, or half the head, because that is the most common form of this headache. Migraine headaches have been known and described for generations. Their existence is well accepted, but their cause remains a subject of intense interest. This interest is intense because, despite the commonly accepted causes which can be helped by diet, medication, and lifestyle changes, there are still millions of people who literally are disabled by their migraine headaches. They have them more than 15 days a month, and have been suffering for more than 3 months to this degree. So for the purposes of this chapter, the distinction between a migraine headache, tension headache, cluster headache, and any other type of headache will be a simple one. If you are reading this chapter, I assume you have already consulted your family doctor, your gynecologist, your neurologist, and most likely a headache specialist, and you have exhausted all the traditional remedies. Yet you still have very frequent headaches, that usually come on with some sort of pattern, initiated or worsened by light or sound, and which may be accompanied by vomiting. Your headache most likely is in the back of your head on one side, but may occur on both sides (bilateral), and may progress to involve the front of your head, usually your forehead. Most likely you are female, although men have migraines too.

## MEDICAL TREATMENT & EVALUATION

It is beyond the scope of this chapter, in a book devoted to the surgical treatment of painful peripheral nerve conditions, to discuss the medical workup you must have before you come to see a surgeon for evaluation of the presence of compression of one or more of the

nerves to your scalp. At the very least, you should A) read the basic concepts of Migraine from Wikipedia, available at <http://en.wikipedia.org/wiki/Migraine>, which is a good basic coverage of the subject, B) have had evaluation to be sure you do not have a brain tumor or vascular malformation (have a CT scan or MRI of your brain), and C) have failed to have your headaches significantly improved by change of diet, avoiding known “triggers” of your migraines, and use of specific “migraine” medication for at least 6 months.

### BOTOX BOTOX BOTOX

Many doctors will offer you a trial of Botox injection to see if your migraines can be helped. If you have not had this injection, you should. Botox and migraines will be discussed in more detail later in this chapter.

**RELIEF OF YOUR MIGRAINE PATTERN FOR A PERIOD OF  
TIME AFTER A BOTOX INJECTION, OR A LOCAL  
ANESTHETIC BLOCK, IS THE BEST PREDICTOR OF  
SUCCESS FOR SURGICAL DECOMPRESSION.**



Figure 13-1B  
The headache by George Cruikshank, 1835

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## CRANIAL NERVE ANATOMY & FRONTAL MIGRAINE

It is time for some very sophisticated definitions of the Nervous System. Do not let this make you “nervous”. It is necessary in order for you to avoid the confusion inherent in common usage of specific words in this chapter.

The Nervous System contains the Central Nervous System, which is the brain and spinal cord, and the nerves that are outside the Central Nervous System, the Peripheral Nervous System (see Figure 13-2). The nerves in the arms and legs, the nerves on the chest and back and belly are peripheral nerves, even though they begin as nerves from the spinal cord. Once those nerves leave the vertebra, through spaces called vertebral foramen, they become covered with a layer of cells, Schwann cells, and are called peripheral nerves. Peripheral nerves, in comparison to the nerves in the Central Nervous system, can regenerate, grow, if cut and reconnected. Also, if a peripheral nerve has pressure applied to it, this nerve can send a message back into the Central Nervous System, reporting injury, and usually interpreted by the brain as a form of pain.

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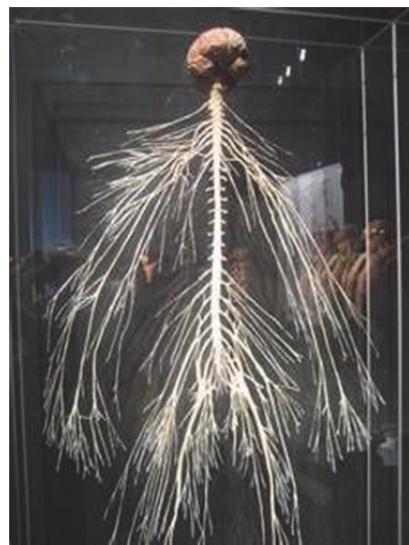


Figure 13-2. Nervous System from flickr.com  
The Central Nervous System is the brain and the spinal cord.  
All the other nerves that come out from the skull and out from  
the spinal cord are the Peripheral Nervous System. Note the skull  
and vertebral bones are absent.

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Schwann cells make a complex protein called myelin that coats individual nerve fibers giving them the ability to conduct impulses more quickly. When the peripheral nerve is compressed, this myelin begins to degenerate. Chronic nerve compression relates to

symptoms that can lead to migraine headaches. *My theory\** is that the pain message from the compressed peripheral nerves travels back towards the brain, and stimulates or simulates a message from the nerves that innervate the inside lining of the skull, the meninges, which are also branches of the compressed nerves.

Your conscious perception is one of headache, not nerve compression.

***Decompression of a nerve related to migraine headaches permits the nerve to regenerate, heal itself, stop sending a pain message, and the migraines can then stop.***

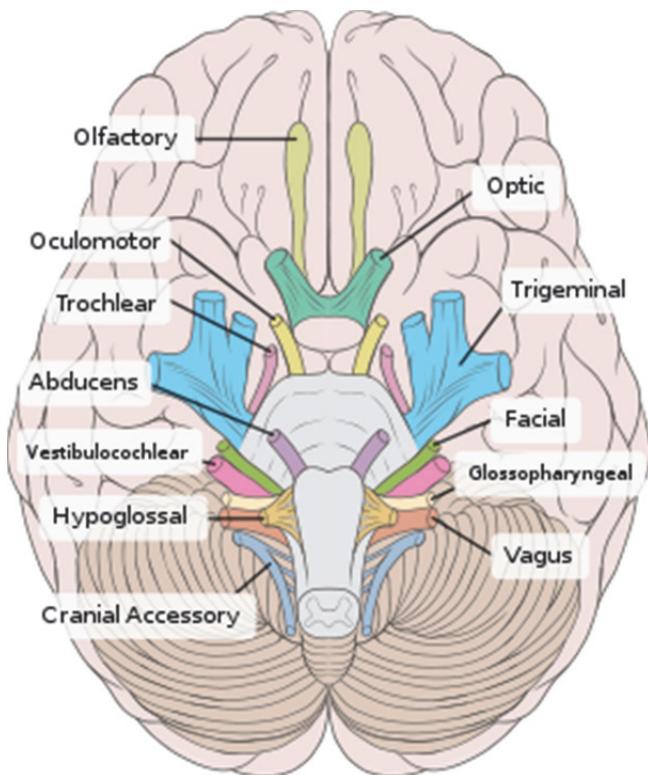


Figure 13-3. Cranial Nerves.

View of the brain from its underneath surface. Each cranial nerve is colored to distinguish it. The functions of these nerves is explained in Table 13-1.

<http://scientopia.org/blogs/scicurious/2011/05/30/science-101-cranial-nerves-iv-and-vi-the-trochlear-nerve-and-abducens-nerve/>

\*Dellon, AL, A Peripheral Nerve Approach to Migraine Headache Surgery; commentary on Occipital Artery Vasculitis Not Identified as a Mechanism of Occipital Neuralgia, by Ducic, I, Felder, JM III, Janis, JE, Plast Reconstr Surg, Manuscript Number: Plast Reconstr Surg, 128:915-917, 2011.

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Nerves that come from the brain, instead of the spinal cord, are called cranial nerves (see Figure 13-3). The first two of these, the ones for the sense of smell, the olfactory nerves, and the ones for vision, the optic nerves, are direct extensions of the brain, and are really part of the brain. Therefore, like the spinal cord, they cannot regenerate. However all the other cranial nerves begin from masses of cells called ganglia that are in a collection called a nucleus. They give rise to a nerve that exits the cranium, the skull, through little holes (foramen), and therefore, like the nerves in the neck and the rest of those that come from the spine into the arms, chest, and legs, become covered with Schwann cells and can regenerate.

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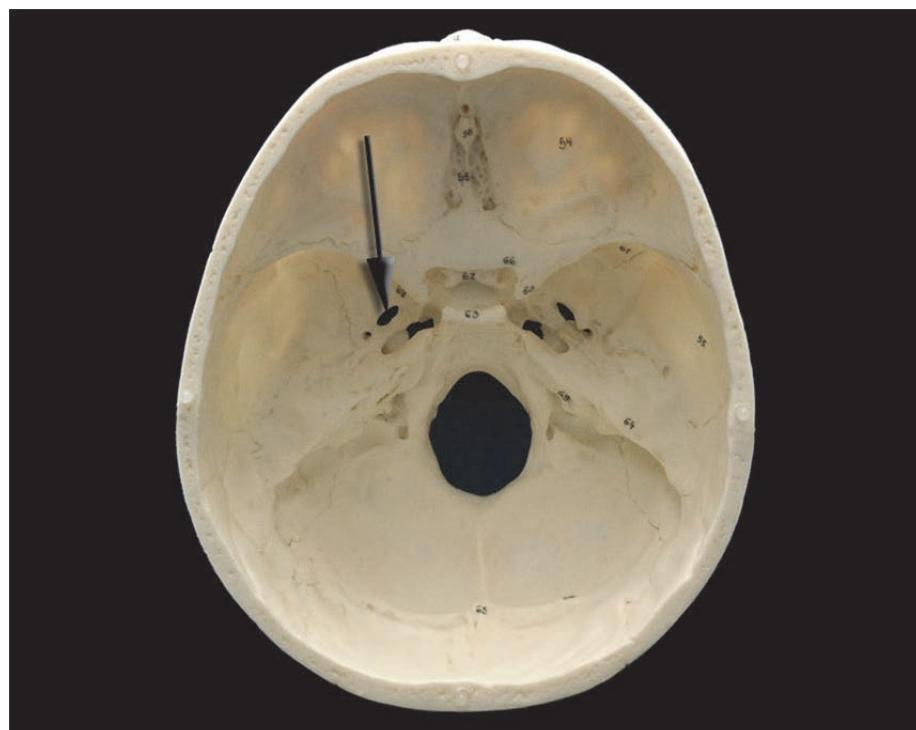


Figure 13-4 Cranial base. The small holes (foramen) in the skull are the exit routes for cranial nerve with the arrow pointing at one called the foramen ovale, through which one of the trigeminal nerve branches, the mandibular, exits to give sensation to the chin and lower teeth. The large hole in the center is where the spinal cord exits the skull.

<http://www.edoctoronline.com/medical-atlas.asp?c=4&id=21899&m=1&p=1&cid=1043&s=>

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These Schwann cells, in addition to forming the myelin that permits the nerve impulse to travel faster, also produce nerve growth factor, that signals a nerve to regenerate. Thus most cranial nerves function as if they were peripheral nerves. This is a critical concept for migraine sufferers.

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The cranial nerves are numbered and their simplified functions are given in Table 13-1.

**TABLE 13-1**  
**CRANIAL NERVE FUNCTION (SIMPLIFIED)**

Nerve Number	Nerve Name	Nerve Function	Comments
I	Olfactory	Smell	Does not regenerate
II	Optic	Vision	Does not regenerate
III	Occulomotor	Eye movements except two	Regenerates
IV	Trochlear	Eye movement down & outward	Regenerates
V	Trigeminal	Facial Sensation	Regenerates
VI	Abducens	Eye movement Outwards	Regenerates
VII	Facial	Facial muscle Movements	Regenerates
VIII	Acoustic	Hearing & Balance	Regenerates
IX	Glosso- Pharyngeal	Swallowing & Throat sensation	Regenerates
X	Vagus	Heart rate & GI Function	Regenerates
XI	Spinal Accessory	Shoulder shrug	Regenerates
XII	Hypoglossal	Tongue movement	Regenerates

It is the V<sup>th</sup> cranial nerve, the trigeminal nerve's ophthalmic branch, V1, that is responsible for the frontal headaches. The V cranial nerve, has three branches, and is therefore called the trigeminal nerve. It is the first branch, V1, the ophthalmic branch, that innervates the forehead through its supra-trochlear and supra-orbital branches.\* These leave the orbit,

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\* Dellen, AL, Discussion of "Anatomy of the supra-trochlear nerve: implications for the treatment of migraine headaches by Jeff Janis, et al, Plast Reconstr Surgery, May, 2013

and travel beneath fibrous bands and muscles to reach the skin of the scalp shown in Figure 13-5. It is at these transition points that the nerves can become compressed to trigger migraine headaches. These skin territories for the three branches of the trigeminal nerve (V1, V2, V3) are depicted also in Figure 13-6. In order to decompress or neurolysis the branches of V1, the tight bands must be released and portions of the muscles causing the compression must be removed. This is demonstrated in the section on surgery techniques. If these nerves have been injured, to create a neuroma, then these branches must be removed, resected, to stop the pain message; decompression will usually not be sufficient. This will leave numbness in the forehead and scalp which are innervated by these nerves.

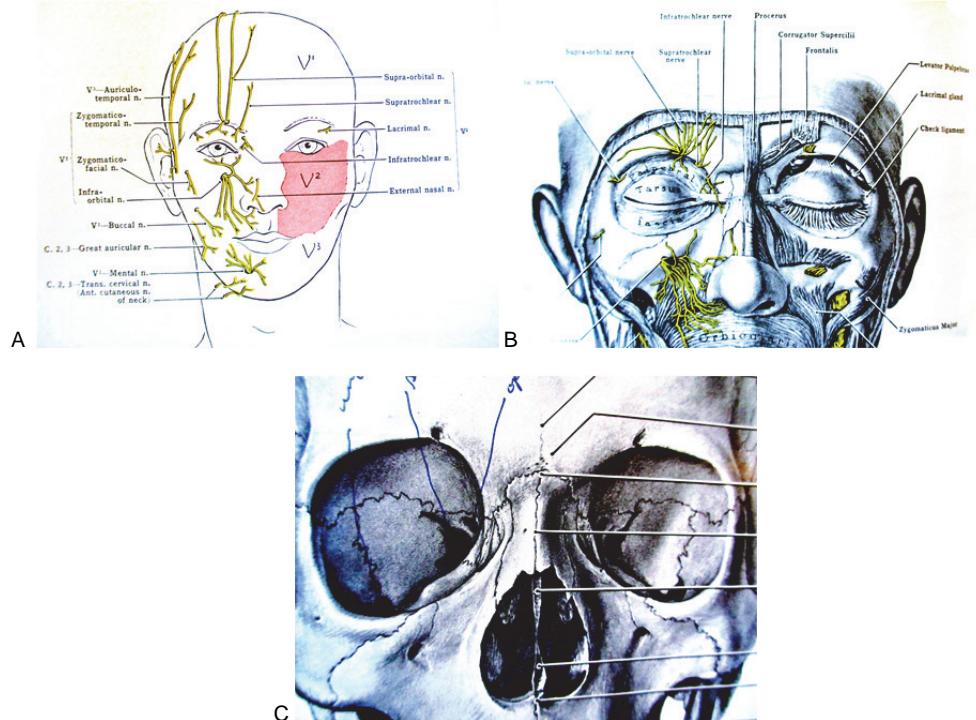


Figure 13-5: Frontal headaches are related to and partially caused by compression of the supraorbital and supra-trochlear nerves. In anatomy illustrations A) and B), these nerves are labeled and are noted at the eyebrow line, or the supra-orbital ridge. Note that there are several branches. The right eye in B) demonstrates the corrugator muscle that compresses these nerves. In C) the boney foramen, or notch, in which these nerves get compressed. (from Grant, JCB, *ANATOMY*, Williams & Wilkins publisher, 5<sup>th</sup> edition, 1962.)

One final distinction on facial pain. When the cause of facial pain comes from within the skull, from the trigeminal ganglion itself or pressure on its nerve root by a blood vessel, the name for the pain is “tic doloreux”, and requires surgery within the skull. In this chapter we

are talking about a peripheral branch of the trigeminal nerve sending pain messages back into the brain, and this is not what is typically meant by facial pain. This is a form of atypical facial pain.

## CERVICAL PLEXUS ANATOMY & POSTERIOR MIGRAINE

The back of the head is called its posterior or occiput. Posterior migraine headaches can be called occipital headaches, and if a nerve, like the occipital nerve (or one of its branches) is involved, then it can be called occipital neuralgia.

The cervical plexus is formed from the dorsal branches of the nerves that come from between the cervical vertebra, and these are sensory nerves. The majority of them exit together in a group of nerves called the cervical plexus, coming from beneath the scalene muscles, and then from beneath the sternocleidomastoid muscles to move on towards their target skin areas (see Figures 13-6 and 7).

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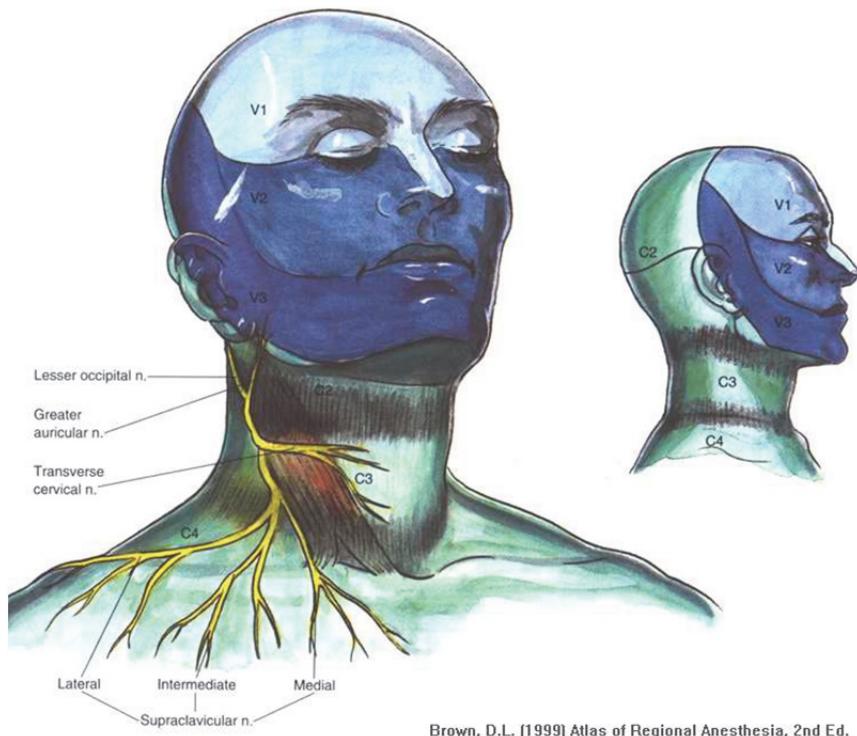


Figure 13-6. Cervical plexus innervates the posterior scalp, neck and shoulder region. The occipital nerve branches are the ones that can be compressed and trigger migraines.  
<http://www.pitt.edu/~regional/Cervical%20Plexus%20Block/cervical%20plexus%20block.htm>

While C2 exits beneath the cervical vertebra and pierces the trapezius fascia, its primary site of entrapment, C3, arises from the cervical plexus to innervate the back of the scalp and neck (see Figure 13-6). The anatomy of the occipital nerves is also seen in Figure 13-7, and

will be discussed more thoroughly in the section on surgical technique. Portions of these nerves compressed by the trapezius muscle must be released by neurolysis.

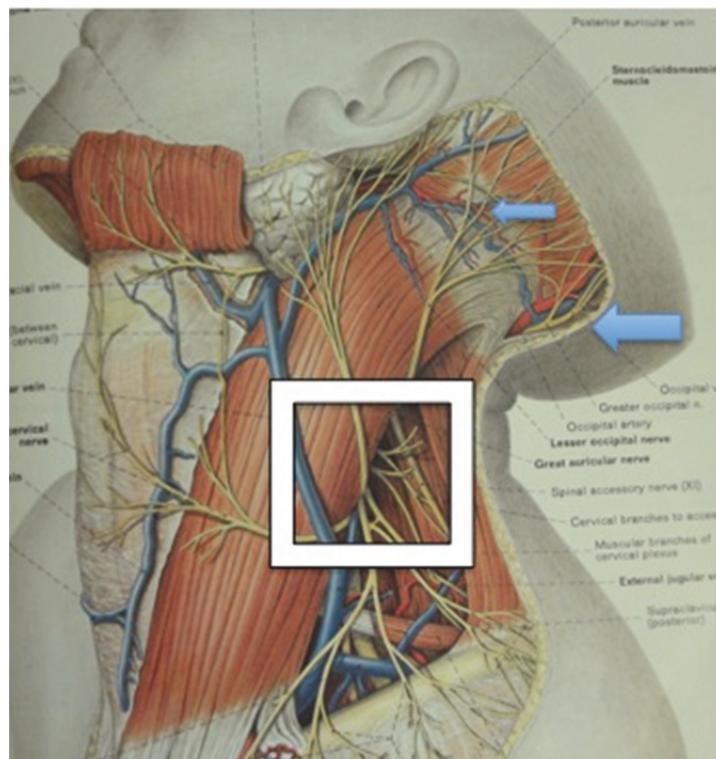


Figure 13-7. Note the cervical plexus arising behind the sternocleidomastoid muscle. Note the greater occipital nerve coming through the trapezius fascia, where it is most commonly trapped, causing the migraine trigger mechanism. Large blue arrow identifies the greater occipital nerve, the small blue arrow identifies the lesser occipital nerve. The white box identifies the exit of the cervical plexus from the sternocleidomastoid muscle. (Clemente, C.D., *Anatomy*, 3<sup>rd</sup> edition, Urban & Schwarzenberg publisher, Baltimore/Munich, figure 578.)

Farther down the spine, after (below) the cervical plexus, begins the brachial plexus which innervates the arm and hand, and these are not involved in the migraine problem, although a tight anterior scalene muscle (see Thoracic Outlet Syndrome, Chapter 5) can cause posterior headaches, by compressing the cervical plexus in addition to the brachial plexus. Many people with brachial plexus compression, in addition to their symptoms of numbness in the fingers and shoulders, also have facial pain and posterior headaches. Therefore, removal of the

anterior scalene muscle not only relieves their shoulder and hand symptoms, but also relieves their posterior headaches in the majority of people.\*

### PARABLE OF THE FOREHEAD LIFT AND THE AURA

One day a 45 year old woman went to see a Plastic Surgeon. “*Doctor, I look old beyond my years. I look tired. My forehead is so wrinkled, can you help me?*”

The Plastic Surgeon examined the woman carefully, noted the wrinkling of her forehead, and said “*Yes, I can help you. The muscles of your forehead have been working very hard, and create those wrinkles. If I remove those muscles, the skin will not wrinkle again, and I can also remove some of the skin at the same time. I have to make an incision in the scalp to do this.* This is called a “forehead lift”. Do you have any medical problems?”

“*Well Doctor, I have been blessed with good health, but I have had migraine headaches for the last ten years. They are located over the front of my forehead, on both sides. I take a lot of medications but I still get them every week. Just before I get them I see lights, and I know the migraine is coming, and I have to lie down in a dark room. Sometimes I stay in bed for two days. Can I still have the surgery?*” “*Yes, you can,*” he said smiling.

And it came to pass that the Plastic Surgeon did operate on this woman, removing certain muscles of the forehead, and also removed the excess skin. She awoke from surgery safely with a bandage on her head.

One week later this woman went back to see the Plastic Surgeon. He removed her bandage. He held a mirror up before her eyes. She gazed into the mirror and said “*Doctor, I look so much better. Younger. Youthful. The wrinkles are gone. Doctor, I am so happy. But Doctor, the real miracle is that I did not have a migraine headache this week!! What does that mean?*”

The Plastic Surgeon thought about this, and said, “Well, that is an interesting observation. I am not sure what it means. Please keep track of your headaches over the next couple of weeks and tell me about them when you come back in two more weeks.

And it came to pass that in two more weeks this woman went back to the same Plastic Surgeon and said, “*Doctor, I really love how my forehead looks, and I have not had another migraine headache!! Thank you so much.*”

The woman lived happily ever after. The Plastic Surgeon’s life was, also, changed forever. He began what was to be a decade of careful clinical observation, and clinical research. We now know that muscle pressure over certain nerves about the skull can cause migraine

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\* Zhang, Z, Dallon, AL, Facial Pain and Headache associated with Brachial Plexus Compression in the Thoracic Inlet, *Microsurgery*, 28: 347-350, 2008.

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headaches. That Plastic Surgeon is Bahman Guyuron, MD, who is now Chief of Plastic Surgeon at Case-Western Reserve, University, in Cleveland, Ohio, U.S.A.

## PLASTIC SURGERY, PROBLEM SOLVING & MIGRAINES

In Chapter 11, of this book, PAIN SOLUTIONS, you can read how Johns Hopkins Medical School instilled in me the desire to take clinical problems into the laboratory, to solve those problems, and to bring the solutions back to help patients. Plastic Surgery is problem solving at its best. Doctor Bahman Guyuron, began the task of understanding the observation made by his patients. [REMOVING MUSCLES OVER THE EYEBROW REGION PREVENTED FURTHER FRONTAL MIGRAINE HEADACHES](#). As it turned out, he began to ask his patients if they had migraines, and if they did, he began to record whether the headaches were better after a forehead lift. Many patients reported that, indeed, their migraines were either improved or gone after the forehead lift procedure. .

“Plastic Surgeons were not looking for a cure for migraine headaches. It was the patients who brought to our attention that their headaches went away after forehead rejuvenation. About the same time, patients claimed their headaches were eliminated following injection of botulinum toxin. It is the elimination of muscle function that is shared by these modalities, one being temporary and the other causing a long-lasting effect.”

Bahman Guyuron, MD, Plastic Reconstructive Surgery, 126:670, 2010

## CENTRAL CENSITIZATION

It is likely that people who develop migraines have the “set point” necessary for stimulation to be lower, or to be more sensitive, than most people for a given stimulus to have an effect. Thus, while a sound or light that might not be irritating to a person with a normal or higher set point, this sensory input is painful to someone with a lower set point. Similarly, while compression of a peripheral nerve over the eyebrow or behind the head of a person with a normal or higher set point may only cause an annoying skin tingling or buzzing, this same stimulus might trigger a frontal or occipital migraine in a person with a lower set point (Figure 13-9).

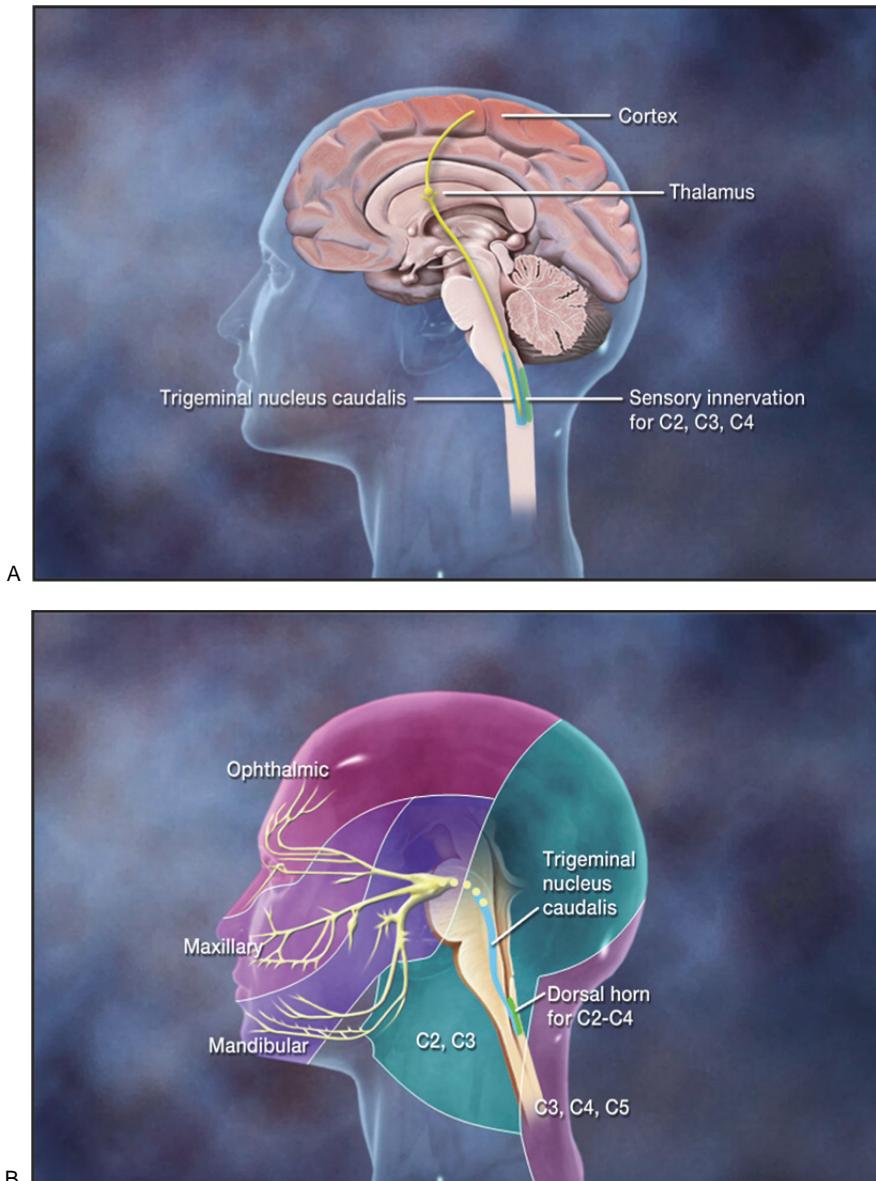


Figure 13-9. Central Sensitization: In A), the person with a normal "set point" for the central nervous system responds in a normal manner when a sensory input enters the caudal nucleus of the trigeminal nerve or the dorsal sensory nerves of C2 and C3, near the base of the brain. In B), the person with the lower set point, who has a lower threshold for a sensory input to stimulate the brain, has many different parts of the brain stimulated at once from the input to trigeminal nerve or the dorsal sensory branches of C2 & C3. (photos courtesy of Neurologist Dorothy Reed, MD, Case Western University, Cleveland, Ohio)

## REFERRED PAIN

If you are among those who have central sensitization, so that a normal sound or light stimulus sets off a headache, how is that compression of the supra-orbital nerve, which usually gives you a tingling sensation in the forehead and front of the scalp, causes a frontal headache. How is that compression of an occipital nerve, which usually gives you a tingling sensation in the back of the head and scalp, causes a posterior or occipital headache? This is the phenomenon of “referred pain”: a stimulus usually perceived in one place is perceived somewhere else related to another branch of anatomical connection of the nerve.

The most common referred pain is the pain of a heart attack being perceived as left hand or arm pain (Figure 13-10). This occurs because the vagus nerve, which sends messages from the heart to the brain, is located near the nerves bringing messages from the hand and arm, and the message from the heart related to dying muscle is interpreted as coming from the hand or arm instead of from the heart. Similarly, the vagus nerve innervates the stomach, and some heart attacks are perceived as nausea, as if the message were coming from the stomach.

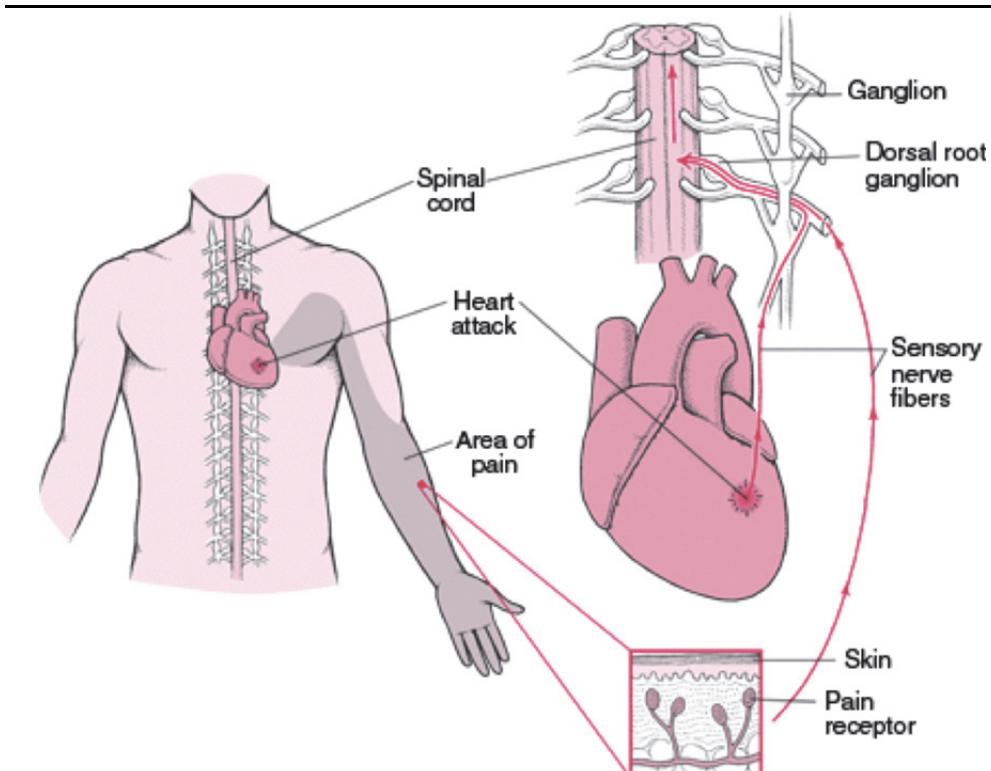


Figure. 13-10 The most common example of referred pain is when a heart attack, instead of being perceived as chest pain, is perceived as coming from the left arm/hand. This occurs because the nerves to the heart and the arm are close to each other in the spinal cord and brain stem, and the signal from the heart is interpreted as coming from the hand or arm.  
([www.merckmanuals.com/home/sec06/ch078/ch078a.html](http://www.merckmanuals.com/home/sec06/ch078/ch078a.html))

## Pain Solutions

With the compression of the supra-orbital (and/or the supra-trochlear nerve), the sensory message travels from the supra-orbital rim at the front of the orbit and continues to travel to the back of the orbit, where it can simulate a message coming from another branch from this same nerve, a meningeal branch, that carries sensory messages from the nerve to the tissue that lines the inside of the skull. A message from the meninges is interpreted as a headache. This scheme for frontal headaches is illustrated in Figure 13-11.

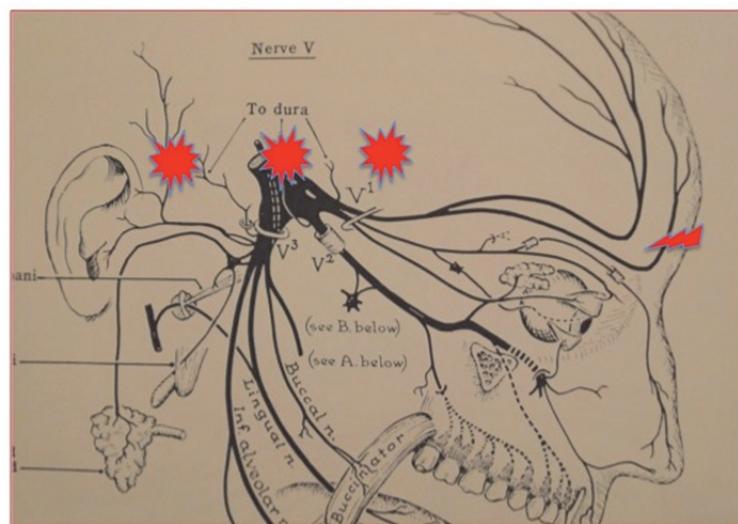


Figure. 13-11 Referred pain from compression of the supra-orbital and supra-trochlear nerves (red lightning bolt) is transmitted towards the brain, where it is interpreted as arising from the branches of this same nerve to the dura (red star bursts). These meningeal branches are involved in the mechanism of frontal migraines. Instead of the brain perceiving the pain as coming from the forehead skin, it interprets the pain as coming from the lining of the brain that is supplied by the same nerve. This interpretation leads to the perception of a frontal migraine headache. (figure modified from Grant, JCB, ANATOMY, Williams & Wilkins publisher, 5<sup>th</sup> edition, 1962.)

With the compression of the occipital nerve(s), the sensation from these branches of the second and third cervical nerves are transmitted to the spinal cord, to be perceived as sensation from the hair at the back of the head, but before they can be interpreted that way they stimulate a connection to the vagus nerve, which gets interpreted as a message from the

\* Dellen, AL, A Peripheral Nerve Approach to Migraine Headache Surgery, Plast Reconstr Surg, 128:915-917, 2011, and

Dellen, AL, Discussion of "Anatomy of the supra-trochlear nerve: implications for the treatment of migraine headaches, Plast Reconstr Surgery, May, 2013

meningeal branches to the tissues that line the back of the skull, the occiput. These messages are interpreted as occipital migraine headaches (Figure 13-12).\*

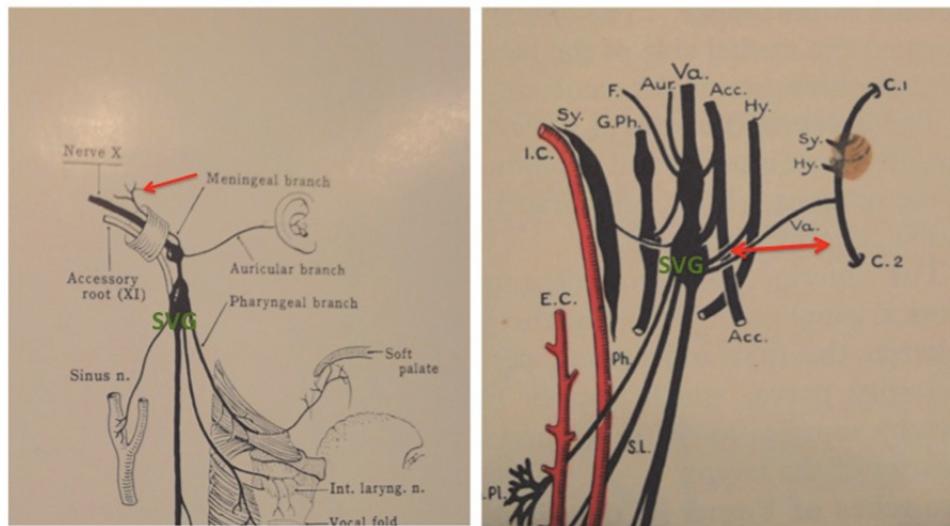


Fig 13-12 Proposed mechanism for referred pain from compression of the occipital nerves. A) The superior vagal ganglion (SVG) has the communication with the tissues that line the posterior cranial fossa. B) Stimulation of the occipital nerves from compression causes a message to be interpreted as coming from the SVG. The perception of occipital nerve compression is therefore not of numbness and tingling in the hair on the back of the head, but rather of a posterior or occipital migraine headache. (figures modified from Grant, JCB, ANATOMY, Williams & Wilkins publisher, 5th edition, 1962)

### A SPECIAL NERVE THAT CAN BE INVOLVED IN MIGRAINE

The zygomatico-temporal nerve is a branch of V1, the ophthalmic branch of the trigeminal nerve. The zygomatico-temporal nerve travels with the lacrimal nerve, instead of with the frontal branch, as do the supra-orbital and supra-trochlear nerves, and so the zygomatico-temporal nerve travels along the orbit on its outer wall, travels then through a little hole (foramen) in the bone to enter the usually depressed region of the forehead, in front of the ear, called the infratemporal fossa. Here the nerve travels through the fascia of the temporalis muscle to innervate the skin of this region. In people with frontal headaches, this area is often tender, and Botox injection into the temporalis muscle will help in relieving this component of the migraine.

\* Dellon, AL, A Peripheral Nerve Approach to Migraine Headache Surgery, Plast Reconstr Surg, 128:915-917, 2011.

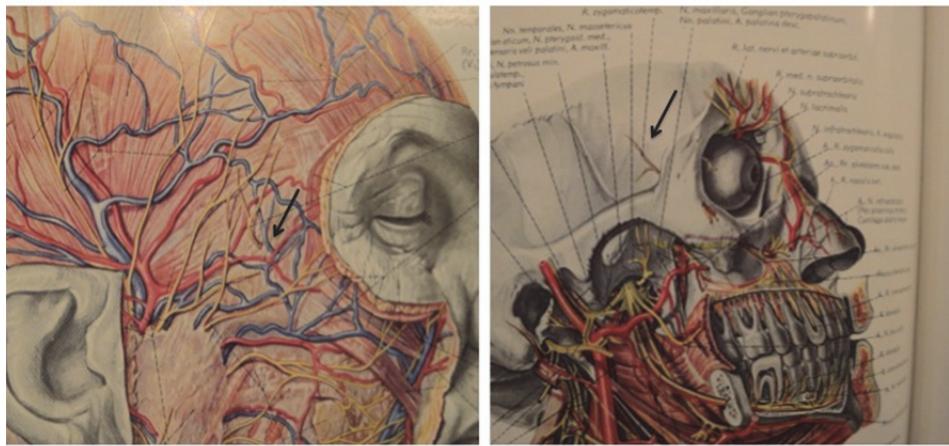


Figure 13-13 The zygomatico-temporal nerve. A. The nerve is noted by black arrow between motor branches of the facial nerve and sensory branches of the auriculotemporal nerve. B. The nerve is noted by black arrow as it exits the skull deep to the temporalis muscle. (Pernkopf, E, Atlas of topographical and applied human anatomy, Volume 1, Head and Neck, Saunders Publishing Co, Philadelphia, 1963)

## NEUROMA VERSUS NERVE COMPRESSION

By definition, an injured nerve forms a neuroma, which sends pain signals, and compression of a nerve causes a decrease in oxygen in the nerve which creates signals that are different in origin. The injured nerve has tried to regenerate and has done so into scar, to form a mass that sends out pain signals. The treatment of a neuroma is to cut out, or resect the neuroma. This leaves an area where the nerve is no longer functioning, so that area of skin becomes numb. The nerve end that is now still attached to the central nervous system must be placed in a location so that it is not stimulated and does not send out pain signals; the most successful technique for this is to implant the nerve ending into a normal muscle. The compressed nerve has decreased oxygen due to decreased blood flow, and sends a message that is interpreted as numbness and tingling (called paresthesias). This can be very unpleasant. The treatment is to remove the pressure, or to decompress the nerve. Examples of these problems in the upper and lower extremity are given in Chapter 1, entitled "Why nerves cause pain". Some examples of this for the facial region are given in Chapter 9, entitled "Facial Pain". In the person with central sensitization, these signals are interpreted as migraine headaches. With respect then to the peripheral nerves, it is important in treating migraine headaches, therefore to distinguish a neuroma from a nerve compression.

**THE CRITICAL DISTINCTION IS THAT TREATMENT OF THESE NERVE PROBLEMS CAN BE SUCCESSFUL IN TREATING MIGRAINE HEADACHES, BUT THE TREATMENTS ARE VERY DIFFERENT FOR A NEUROMA THAN FOR A COMPRESSION.**

**NEUROMA TREATMENT IS NERVE RESECTION.**

**NERVE COMPRESSION TREATMENT IS NEUROLYSIS.**

## WHO IS THE IDEAL CANDIDATE FOR NERVE SURGERY?

The ideal candidate is a person who has 1) disabling, chronic migraines that 2) have not responded to diet alterations, life style alterations, and medication under the guidance of a recognized headache specialist, who 3) has no other treatable medical or neurologic conditions that can be helped further, and finally, 4) who has relief of the migraines temporarily after either a local nerve block or botox placed into the compressing muscle(s).

**THE PERSON MEETING THESE CRITERIA  
HAS AN 88% CHANCE OF SIGNIFICANT RELIEF  
OF THE MIGRAINE HEADACHES,  
LASTING FOR 5 YEARS.\***

## FRONTAL MIGRAINES; NERVE DECOMPRESSION SURGERY

When someone has *no history of direct trauma*, and the headaches are located on the front of the head, the forehead, and including the side of the head, the temporal region, and may include the area behind the eye, then, the appropriate surgery from a peripheral nerve point of view, is to *decompress or neurolyse* the supra-orbital and supra-trochlear nerves. These nerves are branches of V1, the ophthalmic branch of the trigeminal nerve, which then becomes the frontal nerve, traveling across the roof of the orbit, to exit at the supra-orbital ridge (eyebrow), where they are entrapped by the fibrous band across the supra-orbital notch and by the corrugator muscle. These nerves supply sensation to the forehead and scalp as illustrated in Figures 13-3 and 13-5.

### CLINICAL EXAMPLE:

Michelle, a 52 year old married woman, mother of two children, and grandmother of three, had severe right frontal headaches for 25 years. These were disabling, often forcing her to remain in her house, in a quiet, dark room for a day at a time, more than 130 days a year. This occurred with increasing frequency despite her careful diet, her many medications for headaches, and her avoidance of anxiety-producing social events and activities. This was putting an increasing strain on her relationships with her husband and friends. She was not able to visit or play with her grandchildren.

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\* Guyuron, B, Kriegler, JS, Davis, J, Amini, SB, Five-year outcome of surgical treatment of migraine headaches, Plast Reconstr Surg, 127:603-609, 2011.

Her doctor referred her to me for consideration of peripheral nerve surgery. She was tender over the right supra-orbital and supra-trochlear nerves, and also over the zygomaticofacial nerve. Because the surgery would be done through an incision in her upper eyelid, similar to one made for a cosmetic eyelid surgery, blepharoplasty, she asked if I could remove the “excess” or baggy upper eyelid skin from both of her upper eyelids at the time of surgery, and I said “yes”.

This woman’s surgery and post-operative appearance is given in Figures 13-14, 13-15, and 13-16. She is now three years since this surgery was done in April of 2010, and is still doing very well, without migraines.

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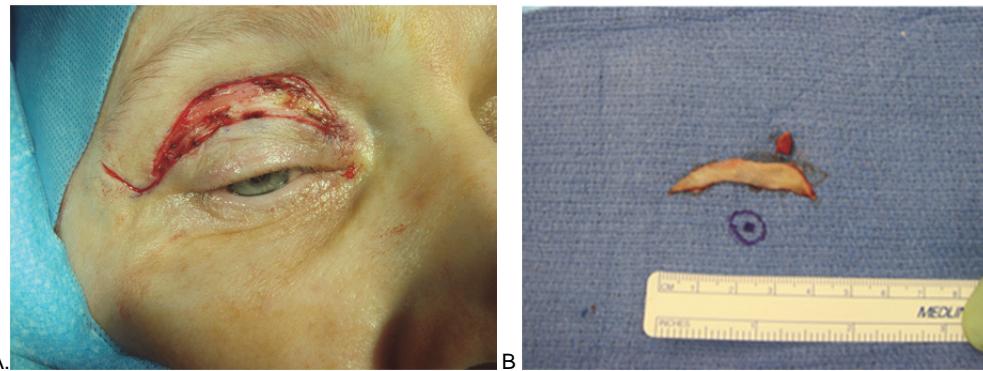


Figure 13-14 Surgical approach to neurolysis of the supra-orbital and supra-trochlear nerves for the treatment of frontal migraine. A) This upper eyelid blepharoplasty incision, used for cosmetic surgery, was also used in this patient to remove the “excess” skin, shown in B) at the time of nerve decompression. The blue circle represents the eyeball, and the red tissue above the eyelid is a portion of the corrugator muscle tissue removed from the nerve during its decompression.

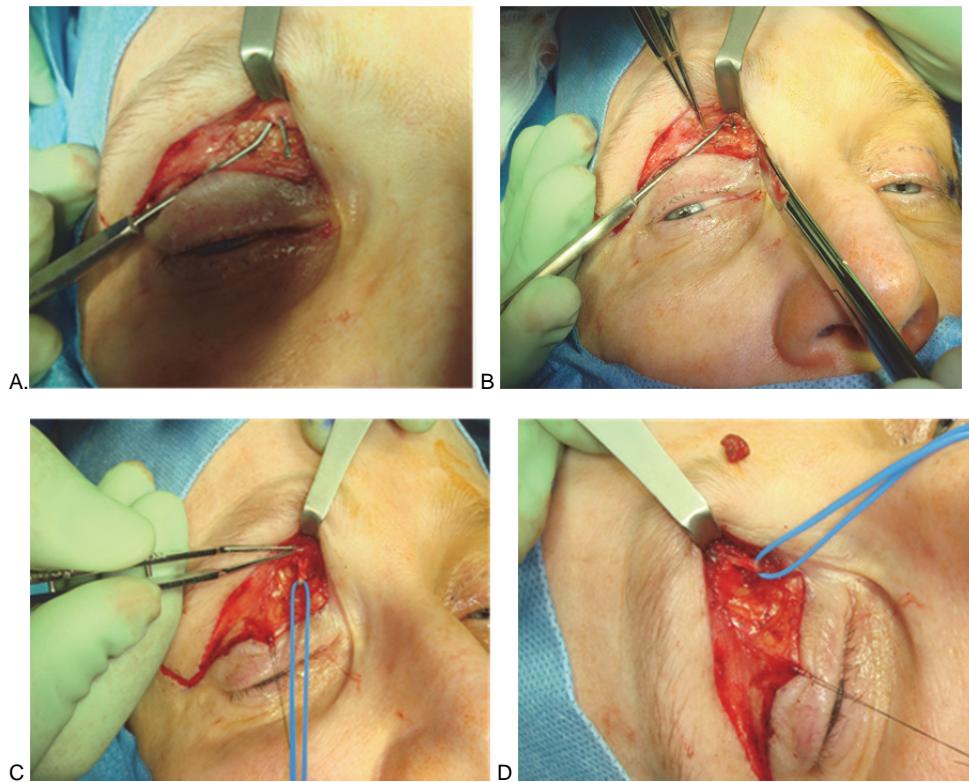


Figure 13-15 Intra-operative views of decompression of the supra-orbital (SO) and supra-trochlear (ST) nerves. Same patient as Figure 13-14. A) the hook is beneath the fibrous band compressing the SO nerve in the supra-orbital notch. This band is then removed. B) The ST nerve is identified beneath the hook. C) The micro-forceps is holding a portion of the corrugator muscle which is also compressing the nerve that is gently retracted by the blue vessel loop. D) The nerve can now be seen after neurolysis is completed, and a section of the muscle, the same piece seen in Figure 13-14B, is noted lying on the skin near the eyebrow.

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After the surgery, I instruct the patients not to bend over for three days to minimize the risk of bleeding. Bleeding behind the eye can cause blindness. There is some bruising after this surgery, but the incision heals very well as noted in the next group of photos (Figure 13-16).



Figure 13-16 The person having the surgery in Figures 13-14 and 13-15 is shown here in A, C, and E, before the surgery and in B, D, and F, at 6 months after the surgery. She did not have a brow lift or forehead lift, as is done in the “cosmetic surgery” approach to frontal migraine surgery, but rather a “peripheral nerve surgery” approach. She did have an upper eyelid blepharoplasty, cosmetic surgery, related to excess skin on her upper eyelids and her age, unrelated to the frontal migraine surgery. She is now three years since the surgery and remains without the disabling right frontal migraine headaches.

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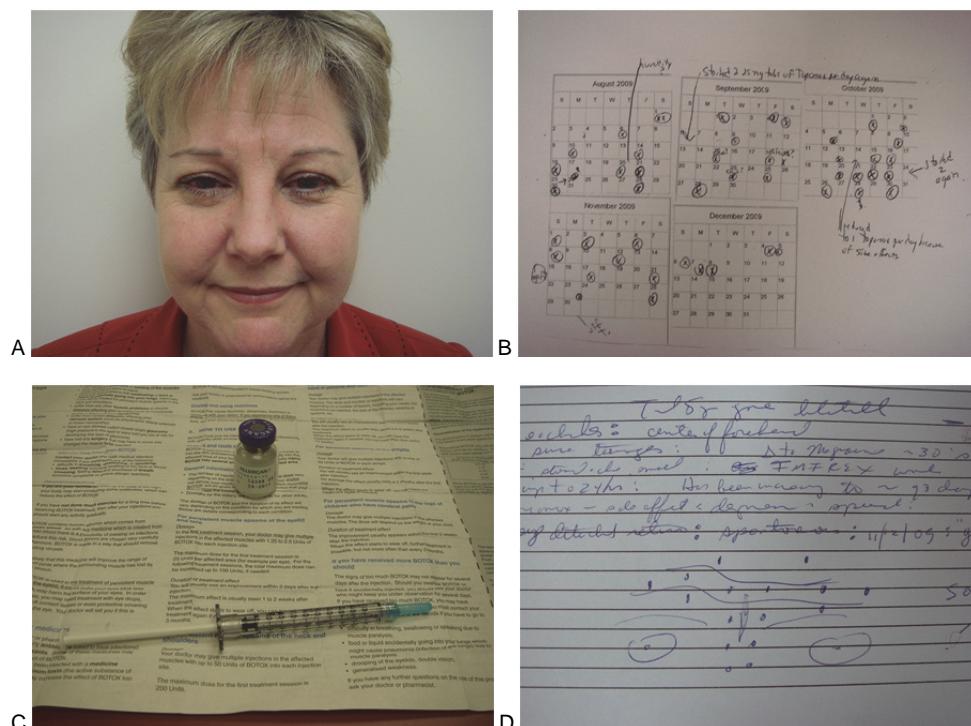
## BOTOX INJECTION FOR FRONTAL MIGRAINES

Christian Andreus Julius Kerner, MD, in 1817 first described the food poisoning that he named Botulism. He chose this name from the Latin for “sausage”, because of the disease came from eating spoiled meat. It is now known that this toxin is produced by a bacteria named *clostridia botulinum*.

Today, Botox is a medicine created from this purified poison. The toxin is specific for blocking the chemical messenger (acetylcholine) that travels from the end of a motor nerve, across a gap to the receptor protein on a muscle cell, creating a paralysis of that muscle cell. Depending upon how much of the toxin is placed, will depend how many muscle cells within the muscle are paralyzed. The paralysis may take a few days to a week to start working and its effect lasts, on average, about 3 months.

A good general description of Botox is available on the internet at <http://en.wikipedia.org/wiki/Botox>. Botox is a drug produced and marketed by a company called Allergan.

Because the face has so many small muscles closely related to each other and in some locations actually overlapping each other. It is important the Botox be carefully injected by someone who knows the anatomy, and in a specific amount so as to obtain the desired effect without paralyzing adjacent muscles (Figures 13-17 and 13-18).



**Fig 13-17 Botox Injection.** A) Typical appearance of forehead "wrinkle" and glabella crease (vertical lines between the eyes) of a migraine sufferer. These wrinkles a reflection of the underlying muscle locations. B) A typical migraine headache calendar useful to document the effect of the Botox injection on the frequency and severity of the headaches. C) Botox is a drug produced and marketed by Allergan, and injected in very small amounts through a tuberculin syringe, due to the high potency of the toxin. D) The pattern and amount of Botox injected is recorded in the chart, and targeted to primarily paralyze the corrugator muscles that compress the supra-orbital and supra-trochlear nerves. Care must be taken not to paralyze the orbicularis oculi or the eyebrow will droop, as in figure 13-18. Prolonged use of Botox will eliminate forehead wrinkles, but may change the shape of the eyebrow.



Figure 13-18. Botox was injected into the left forehead for left sided frontal migraines. A) At rest, note the left eyebrow is lower than the right. B) With attempted eyebrow elevation, the left side is paralyzed. The headaches however are gone. This man is a good candidate for the nerve decompression surgery.



Figure 13-19. Intra-operative photos of patient in Figure 13-18. A) note 3 purple marks at site of the three nerves to be decompressed, the supra-orbital, supra-trochlear, and zygomatico-temporal. B) The incision for neurolysis of the zygomatico-temporal nerve. C) Blue vessel loop is around the supra-orbital nerve and the excised piece of corrugator muscle is noted on the steri-strip that is keeping the eyelid closed. D). Closed incisions.

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## FRONTAL MIGRAINES; NERVE RESECTION SURGERY

When someone *has a history of direct trauma*, and the headaches are located on the front of the head, the forehead, and including the side of the head, the temporal region, and may include the area behind the eye, then, the appropriate surgery from a peripheral nerve point of

view, is to *resect or remove* the supra-orbital and supra-trochlear nerves. These nerves are branches of V1, the ophthalmic branch of the trigeminal nerve, which then becomes the frontal nerve, traveling across the roof of the orbit, to exit at the supra-orbital ridge (eyebrow), where they are entrapped by the fibrous band across the supra-orbital notch and by the corrugator muscle. These nerves supply sensation to the forehead and scalp as illustrated in Figures 13-3 and 13-5.

### CLINICAL EXAMPLE:

A high school senior had years of worsening right frontal migraines. When he was just 6, he had an accident where he fell while bike riding. The right side of his forehead, just above his eyebrow had been cut and sutured in the emergency room. He was on several medications for migraines including narcotics for his severe pain. His narcotic dosage kept increasing as his body became used to the drug. It still hurt whenever this area was touched. His headache doctor had injected local anesthetic into this area which made his forehead and scalp numb, but did relieve his migraine headaches for several hours. He was then referred to me for evaluation for peripheral nerve surgery. The sensory loss related to the injured supra-orbital nerve can be demonstrated with non-painful neurosensory testing as demonstrated in Figure 13-20. The surgery is shown in Figure 13-21.

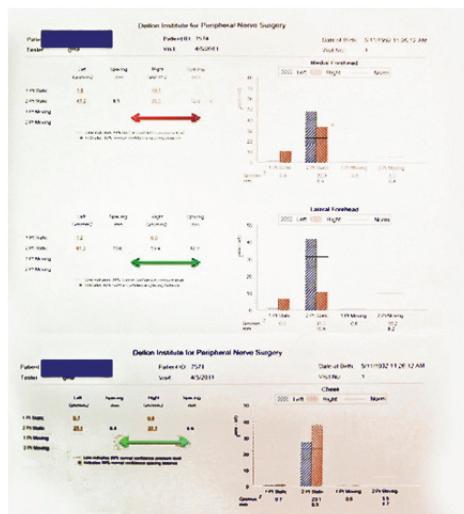


Figure 13-20. Documentation of sensory loss in the distribution of a trigeminal nerve branch, such as the right (red) supra-orbital nerve, versus the left (blue) supra-orbital nerve can be obtained by neurosensory testing with the Pressure-Specified Sensory Device™ (see chapter on Facial Pain for more details). In this patient (seen in Figure 13-21) the red double arrow highlights the abnormal right two-point discrimination (12 mm) versus the normal left (8mm) for the medial forehead, where the original injury occurred. In contrast the lateral forehead (middle panel) and the cheek (lower panel) have the same measurements on the left and the right side (denoted by green double arrow).



Figure 13-21: Intra-operative views of a young man with right frontal migraines caused by a neuroma of the supra-orbital nerve. This nerve was injured in a childhood accident. A) The purple spot marks the site of the painful neuroma and the blue vessel loop is around the supra-orbital nerve. B) the painful neuroma has been excised. C) The proximal (live end) of the nerve is going to be placed deep within the orbit, so it cannot grow back into the eyebrow/scalp area. The metal retractor gently protects the globe (eyeball) while the clamp holds the proximal end of the supra-orbital nerve before it is cut back further and placed more deeply into the orbit.

## OCCIPITAL MIGRAINES; NERVE DECOMPRESSION SURGERY

When someone has *no history of direct trauma*, and the headaches are located in the back of the head (including the back of the neck and top of the head of the head), and the region behind the ear, then, the appropriate surgery from a peripheral nerve point of view, is to *decompress or neurolyse* the occipital nerves. These nerves exit in the side and back of the neck to become entrapped as they pass through the fibrous bands of the paracervical and trapezius muscles to supply sensation to the back of the neck, back of the scalp, behind the ear, the top of the head, as illustrated in Figures 13-6, Figure 13-7 and Figure 13-22.

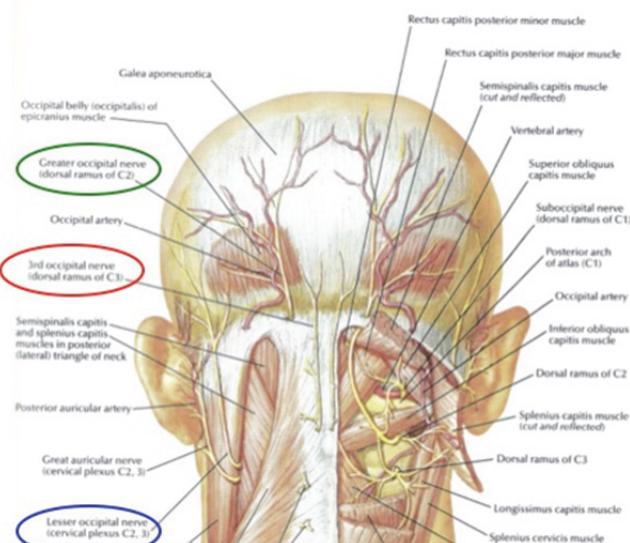


Figure 13-22. Nerves involved in occipital migraine headache: greater occipital nerve (green oval), 3<sup>rd</sup> occipital nerve (red oval), and lesser occipital nerve (blue oval). (modified from Netter, FH, Atlas of Anatomy, 4<sup>th</sup> edition, Saunders, Philadelphia, 2006)

### CLINICAL EXAMPLE:

A 25 year old woman had posterior migraines since she was a teenager. These became worse after her first pregnancy. She had modified her diet, taken many headache medications, and anti-depressant medication. She was unable to carry out her usual daily activities and required help to care for her now 3 year old son. She had relief with Botox injections into the trapezius muscles but did not want to have these injections every three months for the rest of her life, and her doctor referred her to me for surgical decompression of her nerves. Her physical examination demonstrated tenderness over the lesser, greater and third occipital nerves, confirming nerve compression of these nerves, and confirming that she was an excellent candidate for nerve decompression surgery (Figure 13-23, 13-24, 13-25).



Figure 13-24 Surgery for occipital migraines is done with the patient lying on their abdomen (prone position). Therefore the anesthesiologist must protect the eyes and facial structures, with a foam pad, such as shown in A). The patient has an endotracheal tube placed for breathing. B) In the prone position shown here, the hair is not shaved, but an antibiotic ointment is applied and the hair is combed to expose the sites for the incisions.

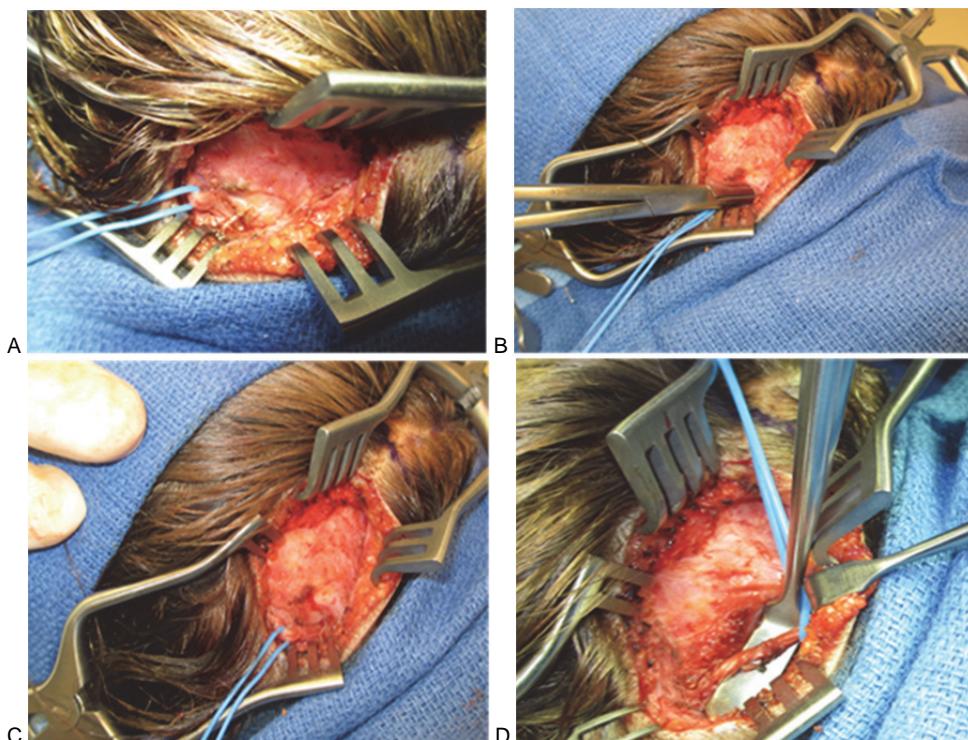


Figure 13-25. Intra-operative views of posterior approach for neurolysis of the left greater occipital nerve. The patient is lying on the abdomen, with the face down. A) The blue soft vessel loop is around the greater occipital nerve after it has exited from the constricting trapezius fascia. This is a normal appearance of the nerve. B) the clamp is passed alongside the greater occipital nerve below the trapezius fascia, prior to releasing the nerve. C) The nerve has now been partially released. D) At completion of neurolysis, three different segments of the nerve can be distinguished. To the left the nerve is whitish and normal. In the central area, the nerve is reddish, inflamed, and narrowed, where it was compressed, causing the symptoms. At the most proximal end, to the right, the nerve has its normal appearance again, and fascicles within the nerve can be seen.

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After occipital nerve decompression, the migraines might be relieved immediately, but more often they are reduced in frequency and intensity early on after surgery, and the improvement continues for 3 to 6 months. During this time, it is appropriate to begin to taper the medications that have the most side effects and the most addicting properties. This may require adding a medication like vistaril (atarax or hydroxyzine) or klonipen (clonazepam) to help with anxiety. After decompression, as the numb areas of the scalp are re-innervated, you may experience tingling, or painful paresthesia. To help with this 3 to 6 week post-operative phase, the neuropathic drugs, like gabapentin (Neurontin) or pregabalin (Lyrica) maybe continued or started.

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Figure 13-26. Same patient as in 13-25. This is the right side with blue vessel loops around the nerves, from left to right, 3<sup>rd</sup> occipital nerve, greater occipital nerve, and lesser occipital nerve. Ear is to the right. Top of the head is at the top of the photo.

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I have found that swimming or standing in the shower has been effective at desensitizing the scalp during this period of time by having the water run over the hair bearing region, stimulating the brain with a known effect that the brain can now identify. This should be done at least once a day. Swimming can be done for 30 minutes for 3 to 6 weeks till the unusual sensations stop. Then the neuropathic pain medications also can stop.



Figure 13-27. For post-operative paresthesias, unpleasant pins and needles, or buzzing, which can occur after nerve decompression, due to nerve regeneration, or after collateral sprouting starts after nerve resection, the best rehabilitation and desensitization occurs by standing in the shower for 5 minutes twice a day or swimming. The water moving across the skin surface stimulates the brain and the known new stimulus is accepted as less painful, or more normal.

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### OCCIPITAL MIGRAINES; NERVE RESECTION SURGERY

When someone has *a history of direct trauma*, and the headaches are located in the back of the head, (including the back of the neck and top of the head), and the region behind the ear, then, the appropriate surgery from a peripheral nerve point of view, is to *resect or remove* the occipital nerves. These nerves are dorsal cutaneous branches of the 2<sup>nd</sup> and 3<sup>rd</sup> nerve roots of the cervical plexus, which exit in the side and back of the neck to become entrapped as they pass through the fibrous bands of the paracervical and trapezius muscles to supply sensation to the back of the neck, back of the scalp, behind the ear, the top of the head, as illustrated in Figures 13-6, Figure 13-7, and Figure 13-22.

### CLINICAL EXAMPLE:

Margret, a 16 year old woman fell while dirt bike riding. She was wearing a helmet. When she fell over backwards, the helmet hit a rock and split open. She had a concussion, and since that time began to develop right posterior, occipital headaches. These were unrelieved all the way through her college years despite her taking appropriate headache medication. At age 23 she began a series of botox injections directed at a painful right occipital trigger point. She did get brief relief of the headaches for a few weeks after the botox injections. Her doctor referred

her to me. Her physical examination showed a firm painful mass over the region of the right greater occipital nerve. Given the clear history of trauma, diagnosis was a neuroma of that nerve, and not compression. The intra-operative views are in Figure 13-28, and the post-operative happy outcome, at the beach with her husband is shown in Figure 13-29.

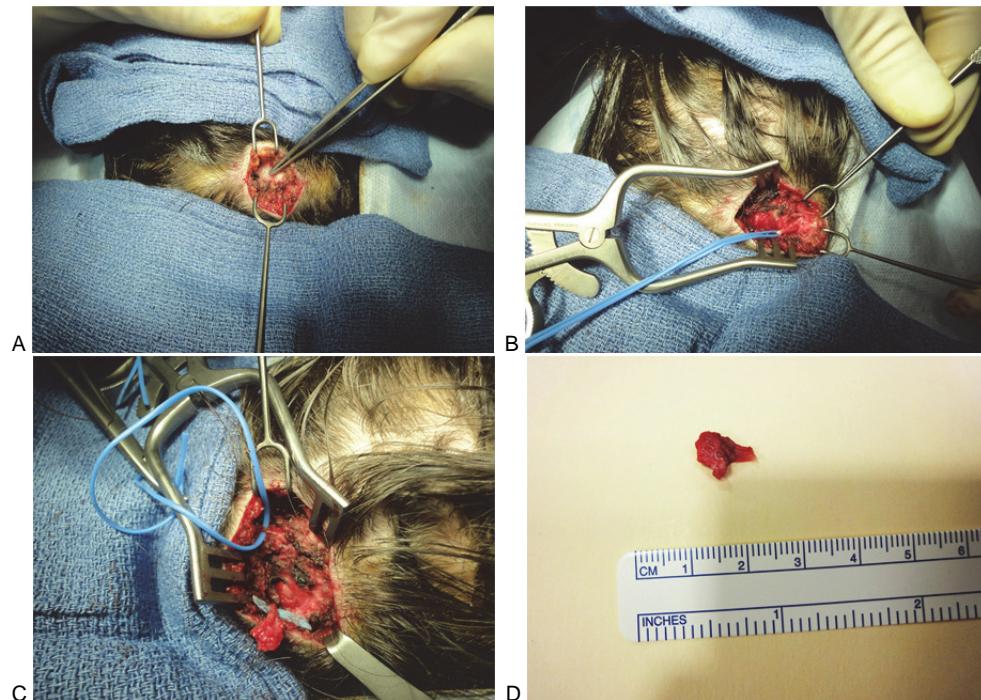


Fig13-28 Intra-operative views of a right greater occipital nerve resection after posterior head trauma induced migraine headaches. A) The forceps is touching the white scar that resulted from the injury. B) The greater occipital nerve is being pulled by the blue vessel loop and the nerve is stuck into the scar where it has formed a neuroma. C) The blue vessel loop is now around a decompressed 3<sup>rd</sup> occipital nerve, which was preserved, and the blue paper is below the greater occipital neuroma that has been removed from the scar. D) The excised neuroma with the occipital nerve going into it. The proximal (live) end of the nerve was implanted into the trapezius muscle to prevent recurrent painful neuroma formation.



Figure 13-29. Patient from Figure 13-28. With headaches gone, she is celebrating on the beach. A happy ending to this migraine story.

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## CONCLUSION

**IF YOU HAVE MIGRAINE HEADACHES THAT HAVE PROVEN REISTANT TO  
CHANGES IN DIET, TO MIGRAINE MEDICATION, TO PAIN MEDICATION, &**

**IF YOU HAVE RESPONDED TO EITHER A LOCAL ANESTHETIC BLOCK OF AN  
ONGOING MIGRAINE OR HAD MIGRAINE HEADACHES RELIEVED FOR A  
PERIOD OF TIME BY A BOTOX INJECTION INTO THE MUSCLES ADJACENT TO A  
KNOWN NERVE TRIGGER POINT, THEN**

**THERE IS AN 80% CHANCE THAT SURGERY TO NEUROLYSE A COMPRESSED  
NERVE, OR SURGERY TO RESECT A DAMAGED NERVE CAN GIVE YOU THE  
RELIEF YOU HAVE BEEN SEEKING. THIS SURGERY SHOULD BE DONE BY A  
SURGEON EXPERIENCED IN PERIPHERAL NERVE SURGERY.**

A. Lee Dellon, MD PhD

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## NOTES



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