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Richard W. Gray

University of Nebraska Medical Center

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TIC DOULOUREUX

By Richard W. Gray

PRESENTED TO THE UNIVERSITY OF
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In this paper I will attempt to present the subject of Tic Douloureux, with the main emphasis on treatment. I will not attempt to describe the various operations, or technique for alcohol injection that have been devised but will attempt to leave with the reader of this paper a better conception of the condition and how treatment has developed through the last hundred years, laying particular emphasis on the modern conception of the condition, and the treatments that have proven best in the opinion of the present day methods of treatment.

Before proceeding further in an discussion, I will define the condition. Tic, is a French word meaning a convulsive motion or fit, particularly of muscles of the face. Douloureux means painful and the two together are taken to mean spasmodic painful contractions of the muscles of the face, unilateral or bilateral in character. This name was applied to this condition by a Frenchman, Nicolous Andre, in 1756. (36) The first record of this condition goes back to Albinus and Galen who described it and suggest that section of the nerve was the only reliable treatment, but it was not until Mareschal, body surgeon to Louis XIV, attempted to do this was this type of treatment tried. Because of the facial muscle contractions during an attack, the condition was considered a motor phenomena. Due to lack of results and conditions this operation was dropped
and the belief became established that the trouble was located centrally and that this type of operation as performed then was of no consequence.

"The fifth, or trigeminal nerve, is a mixed nerve and consists of a large sensory root, and a much smaller motor root. The former supplies exteroceptive fibers to the front part of the head, face, a portion of the external ear, the eye, the nose, the palate, the nas-pharynx in part, the tonsil, mouth and tongue. The motor root is distributed to the muscles of mastication, the mylohyoid and the anterior belly of the digastric."

"The fibers comprising the sensory part of the trigeminal nerve contain general somatic afferent fibers—exteroceptive—which convey sensory impulses from the various head structures, and are the processes of cells lying outside the artral axis in the semilunar ganglion on the sensory root. The portions of the fibers between the periphery and the ganglion correspond to elongated dendrites, while the much shorter centrally directed constituents of the sensory, connecting the ganglion with the hair stern, are the axons of the semilunar neurons. Proprioceptive, general somatic efferent fibers, arising in the neuromuscular and neurotendinous nerve endings in the muscles of mastication are dendrites of neurons found in the nucleous of the mesencephalic root of the fifth nerve.

Proceeding brainward as axons of the semilunar cells, the sensory fibers of the trigeminal nerve become
consolidated into the large sensory root, which passes through an opening in the dura mater situated beneath the attachment of the tentorium cerebelli to the posterior clinoid process. Coursing backward through the posterior fossa of the cranium, it enters the brain-stem on lateral surface of the pons, slightly behind the superior border as the conspicuous group of robust bundles that marks the superficial origin of the nerve. Just above it is the superficial origin of the motor root, from which it is separated by a small bundle of pontine fibers which belong to the brachium pontis. Below and in line with it are the superficial origins of the facial and acoustic nerves.

"In contrast to the median position of the somatic efferent column of nuclei of origin of the oculomotor, trochlear, abducens, and hypoglossal nerves, the deep origin of the motor part of the trigeminus includes groups of cells that lie at some distance from the Raphe and fall into series with the special visceral efferent column of nuclei of the motor parts of the other mixed cranial nerves - the facial, glossopharyngeal vagus and the accessory.

The fibers from the motor nucleus become consolidated into the motor root of the trigeminal nerve, special visceral efferent fibers whose superficial origin is just above that of the sensory root, from which it is separated by some of the superficial transverse fibers of the pons, leaving the side of the pons, the motor root follows the same course to and through the dura mater as does the sensory, to the inner of which it lies. It
eventually passes beneath the semilunar ganglion to become exclusively an integral portion of the mandibular division of the trigeminal."

"The semilunar ganglion is an important complex of nerve fibers, and cells which lies petrous portion of the temporal bone. In shape it is a flattened crescent with its convexity forward, measuring from 1.5-2 cm. of the ganglion presents an irregular longitudinal or reticular striation. From the anterior expanded convex border of the ganglion arise the ophthalmic and maxillary divisions and the exteroceptive, sensory portion of the mandibular nerve, while its narrow concave posterior margin is continued into the sensory root of the fifth nerve. The ganglion lies in meckels space, a cleft produced by a delamination of the dura mater and comes in relation medially with the cavernous sinus and internal carotid artery. Beneath it and unconnected with it, are the motor root of the trigeminal and the greater superficial petrosal nerve. In structure it resembles a spinal ganglion, being composed of characteristically modified neurones from whose single processes proceed the peripherally directed dendrites and the centrally coursing axones."

"Associated with the tree divisions of the trigeminal nerve are four small ganglia. The ciliary ganglion is connected with the ophthalmic nerve; the sphenopalatine ganglion with the maxillary nerve; and the otic and sub-maxillary ganglia with the mandibular nerve. All four receive sensory filaments from the trigeminal, and motor
and sympathetic filaments from various sources; these filaments are called the roots of the ganglia.

The Ophthalmic Nerve or first division of the trigeminal, is a sensory nerve. It supplies branches to the cornea, ciliary body, and iris; to the lacrimal gland and conjunctiva; to the part of the mucous membrane of the nasal cavity; and to the skin of the eyelids, eyebrow, forehead, and nose. It is the smallest of the three divisions of the trigeminal, and arises from the upper part of the semilunar ganglion as a short, flattened band, about 2.5 cm. long, which passes forward along the lateral wall of the cavernous sinus, below the oculomotor and trochlear nerves; just before entering the orbit, through the superior orbital fissure, it divides into three branches, lacrimal, frontal, and nasociliary.

The ophthalmic nerve is joined by filaments from the cavernous plexus of the sympathetic, and communicates with the oculomotor, trochlear, and the abducent nerves; it gives off a recurrent filament which passes between the layers of the tentorium.

The ciliary ganglion is a small, sympathetic ganglion, of a reddish-gray color, and about the size of a pin's head; it is situated at the back part of the orbit, in some loose fat between the optic nerve and the Rectus lateralis muscle, lying generally on the lateral side of of the ophthalmic artery.
its roots are three in number, and enter its posterior border. One, the long or sensory root, is derived from the nasociliary nerve, and joins its postero-superior angle. The second, the short or motor root, is a thick nerve (occasionally divided into two parts) derived from the branch of the oculomotor nerve to the obliquus inferior, and connected with the postero-inferior angle of the ganglion. The motor root is supposed to contain sympathetic efferent fibers (preganglionic fibers) from the nucleus of the third nerve in the mid-brain to the ciliary ganglion where they form synapses with neurons whose fibers (postganglionic) pass to the Ciliary muscle and to Sphincter muscle of the pupil. The third, the sympathetic root, is a slender filament from the cavernous plexus of the sympathetic; it is frequently blended with the long root. According to Tiedemann, the ciliary ganglion receives a twig of communication from the sphenopalatine ganglion.

The Maxillary nerve or second division of the trigeminal, is a sensory nerve. It is intermediate, both in position and size, between the ophthalmic and mandibular. It begins at the middle of the semilunar ganglion as a flattened plexiform band, and, passing horizontally forward, it leaves the skull through the foramen rotundum, where it becomes more cylindrical in form, and firmer in texture. It then crosses the pterygopalatine fossa, inclines lateral-
ward on the back of the maxilla, and enters the orbit through the inferior orbital fissure; it traverses the infraorbital groove and canal in the floor of the orbit, and appears upon the face at the infraorbital foramen. At its termination, the nerve lies beneath the Quadratus labii superioris, and divides into a leash of branches which spread out upon the side of the nose, the lower eyelid, and the upper lip, joining with filaments of the facial nerve.

The sphenopalatine ganglion, the largest of the sympathetic ganglia associated with the branches of the trigeminal nerve, is deeply placed in the pterygopalatine fossa, close to the sphenopalatine foramen. It is triangular or heart-shaped, of a reddish-gray color, and is situated just below the maxillary nerve as it crosses the fossa. It receives a sensory, a motor, and a sympathetic root.

Its sensory root is derived from two sphenopalatine branches of the maxillary nerve; their fibers, for the most part, pass directly into the palatine nerves; a few, however, enter the ganglion, constituting its sensory root. Its motor root is probably derived from the nervus intermedius through the greater superficial petrosal nerve and is supposed to consist in part of sympathetic efferent (preganglionic) fibers from the medulla. In the
sphenopalatine ganglion they form synapses with neurons whose postganglionic axons, vasodilator and secretory fibers, are distributed with the deep branches of the trigeminal to the mucous membrane of the nose, soft palate, tonsils, uvula, roof of the mouth, upper lip and gums, and to the part of the pharynx. Its sympathetic root is derived from the carotid plexus through the deep petrosal nerve. These two nerves join the nerve of the pterygoid canal before their entrance into the ganglion.

The mandibular nerve supplies the teeth and gums of the mandible, the skin of the temporal region, the auricula, the lower lip, the lower part of the face, and the muscles for mastication; it also supplies the mucous membrane of the anterior two-thirds of the tongue. It is the largest of the three divisions of the fifth, and is made up of two roots: a large, sensory root proceeding from the inferior angle of the semilunar ganglion, and a small motor root (the motor part of the trigeminal), which passes beneath the ganglion, and unites with the sensory root, just after its exit through the foramen ovale. Immediately beneath the base of the skull, the nerve gives off from its medial side a recurrent branch (nervus spinosus) and the nerve to the pterygoideus internus, and then divides into two trunks, an anterior and a
posterior."

Branches of Communication.- It is connected by two or three short filaments with the nerve to the\nterygoideus internus, from which it may obtain a motor, and possibly a sensory root. It communicates with the with the glossopharyngeal and facial nerves, through the lesser superficial petrosal nerve continued from the tympanic plexus, and through this nerve it probably receives a root from the glossopharyngeal and a motor root from the facial; its sympathetic root consists of a filament from the plexus surrounding the middle meningeal artery. The fibers from the glossopharyngeal which pass to the otic ganglion in the small superficial petrosal are supposed to be sympathetic efferent (preganglionic) fibers from the dorsal nucleus or inferior salivatory nucleus of the medulla. Fibers (postganglionic) from the otic ganglion with which these form synapses are supposed to pass with the auricolotemporal nerve to the parotid gland. A slender filament (sphenoidal) ascends from it to the nerve of the pterygoid canal, and a small brach connects it with the chorda tympani.

The submaxillary ganglion is of small size and is fusiform in shape. It is situated above the deep portion of the submaxillary gland, on the hyoglossus, near
the posterior border of the mylohyoideus, and is connected by filaments with the lower border of the lingual nerve. It is suspended from the lingual nerve by two filaments which join the anterior and posterior parts of the ganglion. Through the posterior of these it receives a branch from the chorda tympani nerve which runs in the sheath of the lingual; these are sympathetic efferent (preganglionic fibers from the facial nucleus or the superior salivatory nucleus of the medulla oblongata that terminate in the submaxillary ganglion. The postganglionic fibers pass to the submaxillary gland, it communicates with the sympathetic by filaments from the sympathetic plexus around the external maxillary artery.

Its branches of distribution are five or six in number; they arise from the lower part of the ganglion, and supply the mucous membrane of the mouth and the duct of the submaxillary gland, some being lost in the submaxillary gland. The branch of communication from the lingual to the forepart of the ganglion is by some regarded as a branch of distribution, through which filaments pass from the ganglion to the lingual nerve, and by it are conveyed to the sublingual gland and the tongue.

(53)

Some interesting findings regarding the fifth nerve have followed the study of its phylogeny and embryo-
logy. In regard to origin to the fibers represented by the peripheral nerves, in an attempt to determine whether each peripheral branch had a separate origin or not and if they did to determine what part of the sensory root they traveled in and how they were grouped in the gasserian ganglion in an effort to see what relation they had to tic douloureux.

Frazier (47) in his study of the lower forms came to the conclusion that the peripheral branches of the ganglion could be separated in mesial, central and lateral third of the sensory root. Frazier confined his studies to the lower form and did not investigate the human phylogeny and embryology of the fifth.

In the human the opthalmic division is slightly separated in the embryo but when the adult type is studied and can not prove this, as the fibers of all three branches interlace. Serial section of the ganglion failed to prove this point (47).

Wandy (47) stated that after operation, partial section of the sensory root there is no relation between the part of the sensory root divided and the sensory alterations that follows, his conclusions regarded this subject after many opportunities for observation of results were "Observations, such as described deny the hypothesis that the peripheral branches are
accurately represented by subdivisions of the sensory root. Doctor Mouhuys 1932 (47) in his studies on this same problem concludes that:

1. "The sensory root is not composed of three parts that correspond to the three peripheral branches from the ganglion.

2. The operation of partial section of the sensory root, assuming that the pain is carried by bundles having a definite location, is not based on anatomic facts, and therefore cannot be regarded as an absolutely reliable procedure."

Now that the anatomy and embryological aspect of the fifth nerve have been reviewed and somewhat refreshed in our minds I will take up the discussion of the condition itself.

True trifacial neuralgia (27) or the so-called tic-douloureux, or epileptiform neuralgia as it is sometimes called is a distinct entity, diagnosed entirely by its symptoms as the physical findings are usually negative. The attacks are at times accompanied by facial spasm, although these may be absent at times. The disease usually appears in the latter period of life and has as a result been referred to as a disease for the "degenerative period of life." An analysis of some 200 cases shows that 93% developed in the fourth decade or later.
The neuralgia is characterized by pain along the distribution of one or more branches of the fifth nerve, and more frequently on the right than the left side, a ratio of 2-1. This fact can not be explained and is the conclusion resulting from the observation of many cases. The disease is seldom bilateral, both sexes are affected and there seems to be no predisposing factors. Head states that the patients "are in no sense of the word neurotic" while other men such as Uppenheim, Grasset and others feel that a "neurasthenic" disposition plays an important role.

The branches of the nerves involved according to our studies is localized in the second and third divisions. The first division is seldom involved alone, if it is, it is not a true neuralgia at all. The lower two divisions are most commonly involved, but to say which is the most frequently, observers vary in their opinion. Not infrequently two branches are involved at the same, and when this occurs it is in adjoining branches.

The pain of trifacial neuralgia is typical, the pain is of short duration, an a continuous aching of throbbing is not true tic douloureux. The pain has been described as a shooting, stabbing, burning or cutting in type and it never passes the midline in front during an attack. It appears in attacks with definite intervals in between when
there is a freedom from pain. Early in the disease the remissions may be several months or years, and as the case progresses the intervals are shortened.

Any stimulus may precipitate an attack, such as eating, touch, wind blowing on face, change of temperature, and these zones which when touched precipitate an attack are called "dolor genetic zones" they are usually located about the mouth, or alae of the nose.

Valleix (36) was the first to point out these spots or trigger zones as they are sometimes called and describes them along each individual branch as follows,

"In the first division, the supraorbital notch, the junction of the nasal bone and cartilage where the nasal nerve emerges, and the inner angle of the orbit where the trochlear nerve becomes superficial.

On the distribution of the second division the most common foci are the infraorbital foramen where the nerve of the same name emerges, and the malar foramen in the malar bone pain may be also more experienced but more rarely, along the upper gums or in the upper lip, and there may be a focus in the palate, a somewhat unusual one, but when it does exist is is the sect of intolerable pain.

In the territory of the third division, the inferior dental nerve and the lingual are the most common seats of severe pain, but it is sometimes experienced in the auriculo-temporal region just in front of the ear, and more rarely in the lower lip."
(41) The pain of trifacial neuralgia is the most severe types of pain that the patient has to endure, and if not relieved may commit suicide.

At the onset the pain is usually located in only one branch more often second or third, and sometimes in the first. It may remain localized for some months or years but eventually spreads to the other branches.

The pain comes in paroxysms, and it is this type of paroxysmal pain that serves to differentiate tic dououreux from other types of facial neuralgia. The pain lasts only a few seconds and may occur any number of times in a day. The slightest stimulus usually precipitates an attack, so during this time the patient usually protects the face with a towel or handkerchief, and washing the face, combing the hair, shaving, are avoided and frequently these patients have a seborrheic dermatitis, and are dirty, unkept and usually under weight and undernourished due to the fear that some stimulus will cause another attack.

The participation of the facial nerve may or may not be noted, and when it is, is manifested by an involuntary unilateral contraction of the facial muscles. One usually sees a marked unilateral vasomotor reaction (flushing) on the affected side as well as a hypersecretion of the lacrimal, salivary and nasal glands on the affected side.
The sensations of the face are not lost unless operation has occurred, so if there is a loss of sensation, it is highly probable that the diagnosis is wrong. Remissions are characteristic of the disease, and the condition is predominately in the female, more frequent in the right side and seldom bilateral.

1. Pain is the only symptom, and has been described as stabbing, lancinating. The condition is a chronic one and a true case does not simulate migraine, sinus pain or dental caries and a case has never been relieved by sinus drainage or extraction of teeth.

(50) There is a tendency to remissions but the pain always recurs. The presence of other injections about the face has no course upon the disease and recovery under proper treatment is permanent regardless of the other existing conditions. In a series of cases 200, the side affected was as follows:

1. Right side 52.3%
2. Left side 40.9%
3. Bilateral 6.8%

In this series 96 were in men and 104 in women.

(10) There is only one neuralgia which will give some difficulty in making a differential diagnosis and that is the one described by Dr. Sluder.

"This neuralgia has not to such an extent the essentially spasmodic character of tic douloureux, rather
it is during the attack a more or less constant ache or pain with spasmodic exacerbations which last several minutes. It begins at first as a rule about the root of the nose and as time goes on ranges across the floor of the orbit, over the temple to the ear, to the mastoid, the side of the neck to the shoulder and a last even involves the whole upper extremity. A point where pressure show tenderness and where pain is often very severly felt is just to the inner side of the base of the mastoid process. In this disease cocainization of the mucosa of the outer wall of the nasal chamber on the side afflicted in the middle region of the posterior end of the middle turbinate will give relief.

Frazier, C. H. (25) states that the tic patient never craves opium and, what ever the type of pain if patient is an addict, the condition is not tic douloureux. Morphia has no place in its treatment it only dulls the pain and never gives any relief from symptoms.

Wilson, V. C. (63) in his studies of facial neuralgias wherein the cause was due to teeth or sinuses, in clear up after cleaning up foci of injection, while the neuralgia of the separate nerve, such as the glosso-pharyngeal and trigeminal are separate entitys and they should not be confused.
In cases in which the lingual nerve is affected there is a furring of the tongue of the affected side, but this condition is also present when this is not affected so it is probably due to the fact that the patient masticates his food on the unaffected side. Another point in the diagnosis of this condition is the fact that these patients can sleep at night, and are entirely pain free when asleep. In the atypical forms of facial neuralgia where the pain is constant and not paroxysmal in character the ability to obtain rest at night is difficult.

As to the etiology of the condition true to tic douloureux (1) has no known etiology. Sir Victor Hasley (36) has stated that it is possibly caused by dental injection resulting in an ascending neuritis, but this is not generally believed, that if this was the case, one would get a motor as well as a sensory paralysis. It may be a sclerosis or a degenerative lesion in the ganglion which causes the symptoms to develop. The disease is not hereditary, although there are cases on record where more than one member of the family were afflicted with the condition. The neuralgia usually affects the inpa-orbital division first then the mandibular and lastly the ophthalmic division.
Vana, C. L., 1900 (12) considers it a degenerative neuralgia occurring past middle age and amounting to sometimes a neuritis in the nerve and its ganglion and probably in the blood vessels which supply it. It attacks women about twice as often as it does men. It rarely attacks men before the age of 40, while it is three to four times as frequent in women under 40 than it is men.

A common previous disorder to tic douloureux is that of migraine, while another is over work or strain, so may also begin as an acute trigeminal neuralgia associated with herpes, or local disease in teeth and gums.

It is primarily a disease of the second and third divisions of the fifth nerve. Rarely does it begin in the first division. There are two types according to Dr. Dana.

"Type I" is that of the migrainous type of early life is considered an evolution of a definite fifth nerve neuralgia on the basis of a migrainous neuralgia, and the trouble is originally central and not a disease of the gasserian ganglion. It is possible that the fibers of the fifth through some inherent defect incur degenerative changes and a true neuralgia develops, but let it be remembered in the early stages there is little real disease in the fifth nerve. It is a disorder of a central sensory neuron."
"Type II" is the most common occurring after forty and affecting man at least half as often as it does women, and it usually starts as a true infective neuritis in the form of herpes or ascending neuritis, due to some disease of the gums, or antrum, asseous tissue, some of these run an acute course of a few weeks to a few months and are easily cured. Tic dououreux is sometimes purely symptomatic of some local disease.

The natural course of these two types is interesting because the patient who has the migrainous tic of early life, finally localizing, rarely gets cured. The tendency toward remissions is common, and it has a tendency to disappear often after the age of fifty.

Patients of this type are seldom permanently benefited by any treatment and if surgery is attempted there is a tendency to recur, because the trouble does not lie excusively in the trigeminal nerve but also in the central nervous system.

In the second type beginning after forty, there is a tendency toward spontaneous cure without any treatment the course of the disease being all the way from five to twelve years. It usually reaches its height at the fifth to sixth year and then gradually subsides. The duration of the incurable form may be the life of the patient, and one of the most characteristic features
of the disease is the tendency to remissions."
Frazier (27) believes it is due to primary sclerosis of the gasserian ganglion. Beckman (5) believes the disease starts as a peripheral neuritis and finally involves the ganglion. Removing the peripheral branches involved early in the disease does bring temporary relief.

Frazier (25) says "that it is not due to any systemic ailment, to any toxic influence, to any focus of irritation we are morally sure". The nerve is quite richly supplied with blood vessels and sympathetic connection and what could be more logical factor than a spasm of the vessels and a transitory ischemia to account for this condition, without any structural changes in the ganglion.

Ellis, C. W. (28) in regard to etiology gives a report of eight cases in which the patient had asymptomatic maxillary sinusitis with negative x-ray pictures, brilliant translumination, no pus in nose, and no naso-pharyngeal catarrh. This condition of the sinuses was discovered only after using direct vision. In this event these cases cleared up and were symptom free after sinus condition was taken care of. His ideas as to the evidence of tic douloureux is that it is not a rare disease, and is only slightly less common than sciatica.
Dandy, W. E. (17) in a series of cases (215) of tic douloureux reports that in "twelve cases he discovered tumors impinging upon the trigeminal nerve, pressing on sensory root as a tumor of the ganglion does not give the same symptoms. Six cases where he discovered aneurysms of the basilar artery. Five cases caused by angiomas. Sixty six cases by artery on nerve, artery scleratic and under gone changes and pressing on nerve. Thirty cases of vein on nerve. Two cases of congenital anomalies. Seven cases where sensory root adherent to brain stem. Eighty seven cases where there were no gross findings what so ever." On the cases where no gross findings where observed, the only thing that we can conclude is that some intrinsic factor must exist, and this without destruction of the sensory function.

Dandy, W. E. (16) thinks "that the origin of the pain is as observed in tic, because of its paroxysmal character is evidence enough that it has its origin in a higher sensory leve, just as clanic convulsions are evidence of origin in a higher motor leve.

Peet, M. M. (51) as a result of his studies concludes that since the sympathetic system carries only efferent fibers, it can concerned only in pain of the face where the difficulty is due to vaso-motor spasm. Frazier has attempted to relieve patient by operative procedures on the cervical sympathetics but without a great
deal of success.

True tic douloureux has no pathology but Hutchinson, J. (37) notes that there is some increase in the intercellular fibrin, and slight round cell infiltration of the ganglion but as a rule no pathology is found.

Nothnogel (36) says the atrophy of muscles was noted by Cotugno in 1760. The wasting is ascribed to vaso-motor spasm, other men have noticed trophic changes such as blanching of the hair, thickening of the tissue, iritis and glaucoma. Keen., W. W. (41) finds some changes in the ganglia that he removes but it is extremely difficult to remove the ganglia without some trauma.

A condition such as tic douloureux which has no definite etiology or pathology is usually a condition where what to do for the condition was discovered by the old trial and error method.

The first form of treatment which we will consider is the medical.

Frank, L. W. (27) believes that drugs have no place, and when tried are usually found to be useless, and surgery must usually be restored to.

Dana, C. L. (12) used heroic doses of strychnine in anemic or exhausted cases, and has arrested or controlled the disease. The opium treatment is very dangerous and is not very effective, only dulling the sensation, never relieving the patient of pain, the real danger is from
the opium habit, and it takes an ever increasing size of
dose, up until the patient is taking enormous doses to
control his pain. Other drugs have been tried and found
useless, if medical treatment is reasonably successful, it
may give a remission from six to ten months. Some patients
have even been cured by Christian Science but is doubtful
whether they had true tic.

Hirschkonn, (33) says that in the treatment of
trifacial neuralgia (amte) most anti-neuralgic drugs may
succeed. The quickest results are obtained by repeated
fifteen grain doses of sodium solicylate, or seven and
one-half grain doses of quinine. The the chronic cases
better results are obtained by certain combinations, such
as pehacetin and quinine, cannabis indica with salicylic
acid, chloral hydrate with morphine, and the bromides with
morphine or bellodonna.

Inshkiep, L. D. (39) discovered by accident a
satisfactory treatment, but whether it has any bearing on
the etiology has not as yet been decided. The treatment is
simple and inexpensive. It was found that the simple
administration of one heaping teaspoonful of calcium glu-
conate in a glass of water, one half hour before breakfast
was enough in even the most severe case to produce a sub-
sidence of all symptoms. It is gradual and takes from seven
to fourteen days to complete. It is first noted that it
takes a stronger stimulus to produce an attack and latter
an a burning sensation along the path of the nerve, and
within fourteen days both pain and burning sensations are
gone. In some cases the calcium could be discontinued
for as long as eighteen months before an attack, and at
which time the calcium was as effective as before.

Relapses occur and these usually following a
"bout with Bacchus" chiefly respiratory injections, but
these relapses can be overcome like the first with the
continual use of calcium.

The advantages of this type of treatment are
according to Inskiep are:

1. Non-habit forming
2. Non-operative
3. Not injurious to health
4. Does not disturb sensation

Tyler, C. M. (61) used ergotamine tartrate in the
treatment of tic douloureux because of the belief of the
rule that the sympathetics play an important role in the
condition, as shown by Frazier, and upon certain data ad-
vanced by Davis and Pollock. Assuming that the pain of
tic is in some way associated with overactivity of the
sympathetics—Then this whole set of symptoms may be attri-
buted to over activity of the sympathetics, since ergotamine
tartrate has been proven both clinically and experimentally
to be a powerful depressant of the sympathetic system. It
is of benefit in patients who show an sympathetic un-
balance.

Flotoyow, P. G. (28) noted that during the war
the workers in certain munition plants were found to be
developing an anesthesia of the face, and it seemed to
have a special affinity for the trifacial nerve. The
cause was traced to a drug known as triclorethylene,
and since then has been used as a treatment for this
condition. Fifteen to twenty drops being placed on a
gauze and inhaled, the treatment must be continued for
a considerable length of time before any results are
obtained.

Inger, I. M. (38) suggests that recent cases of
neuralgia of the fifth pair have to be treated by purgatives
and hot air apparatus after the method of Bier and especially
by massage, peripheric and central novocain injections are
successful too.

Stewart, D. and Lambert, V. (58) feel that the
sphenopalatine ganglion by its numerous anastamosing branches
is in some way responsible for the pain of tic although
the ganglions function is not definitely known. It was
cocainized by means of soaking a swab in adrealin 1-1000
solution, then placing in cocain crystals and applying to
the ganglion which lies on the lateral nasal wall opposite
the posterier end of the middle turbinate and in some case
alleviated the symptoms.
Dubois, '18) reports a case treated by galvanic current, previous to his electrical treatment had been treated with drugs and obtained no relief. "The positive pole, divided into three terminals by means of a divided rheophore, was applied to the supra-orbital nerve, the infra-orbital nerve and at the mental foramen. The negative pole was placed on the neck opposite the superior cervical ganglion from twelve to fifteen milliamperes as it is estimated were passed for fifteen minutes." After such treatment patient had relief, in three weeks treatment a complete remission and after a years treatment (three times a week), he has remained free from attack for twenty six years. The use of electricity (36) has been largely replaced by alcohol injection or surgery when it fails to give results.
Rynd (1840) (46) was the first man to sue the injection treatment of the peripheral nerves for neuralgia. In his attempts he used horphine and creosote but his results were unsatisfactory.

Bartholomur (1874) (26) was another of the first to attempt the injection of the nerve with some type of fixing fluid, and he used chloroform but this was promptly abanded, because the results were transient, and it failed to produce neuron degeneration.

Billroth and Neuber 1884 (26) proposed the use of asmic acid, it had its period of popularity. The injections were first made into the nerve foramina. The relief of pain was of short duration and the results inconstant. They also attempted to inject the nerve at higher levels and thus delay regeneration and increase the length of the periods of relief. The one objection to the treatment was that the acid caused tissue necrosis and searing resulted.

Eastman, R. R. (19) described a technique of injecting a 2% solution of asmic acid into the nerves. Ten drops of 2% solution were injected in each branch and two or three drops were forced into the perineural fat of each foramen and around the nerve.

The paroxysms occurred several times during the week following injection and then gradually subsided. The respite of the pain which follows in his opinion
justifies an operation so easy of performance and attended with so little danger.

Babcock, W. W. (4) also describes his use of osmic acid as the material to be injected into the nerve using 1% osmic acid. As it is known that the acid has an known affinity between itself and certain portions of the nerve, and there is evidence when it comes in contact with the nerve that it produces a permanent necrosis which results in destruction of the portion of the nerve acted upon.

Bennett, W. H. (1897) (4) began injecting the nerve trunks after suitable exposure and he obtained relief from symptoms by such treatment for a period of over four years.

The efficacy of the injection seems to depend upon two factors. "First the thorough destruction of nerve filaments and adjacent tissues produced by the osmic acid; and secondly, the fact the area of destruction becomes filled by a mass of scar tissue impermeable to sensory impulses."

Locally the acid produces a marked necrosis of the tissue, but if the wound is properly taken care of there is no danger from secondary infection and abscess formation. Occasionally only partial relief results probably due to the fact that all connecting and anastomosing fibers have not been destroyed.
Scholosser 1900 (27) demonstrated that following the injection of the sensory root with 80% alcohol there was a period of numbness, and then the gradual return to normal sensation without the pain. Each of the divisions can be injected separately, although the injection of the first is seldom attempted due to its location to the vessels, the motor nerve and optic nerve of the eye.

Complications which may follow are keratitis, especially after the first and second division have been injected. Paralysis of the sixth, hematoma and ecchymosis; stiff jaw and occasionally injecting alcohol into the nas-pharynx.

Hartell (27) devised a technique by which the ganglion itself could be injected, but in twenty five percent of the cases corneal ulcers developed and the method has fallen into disrepute.

Locke, C. E., Jr. (41) states that there are only two methods that give any satisfaction are "an interruption of the peripheral branches of the nerve by alcohol injection or peripheral neurectomy." The second and third branches easily injected near their exit from the cranium and such injection may last anywhere from six months to two years. The relief is never permanent.
Flothow, P. G. (28) states that alcohol gives good temporary relief in about fifty per cent of the cases.

Inger, I. M. (38) gives some indications for alcohol injection which are:

1. "Chronic cases with localization in single branches should be treated by peripheric alcohol injection into the sskell base.

2. Severe and relapsed cases after peripheric injection must be inter-cranial injections into the gasserian ganglion. These must be repeated till a permanent anesthesia has supervened.

3. Resection of the gasserian ganglion is indicated in cases of failure in spite of repeated intercranial injections, and in those when frequently undertaken punctures of the oval foramen do not succeed on account of anatomical conditions.

4. Peripheric and central alcohol injections are indicated in cases of neuralgias caused by inoperable tumors."

Cushing in 1919 (26) emphasized the fact that the deep intracranial injections of alcohol in the maxillary and mandibular nerves had replaced peripheral neurectomies and suggested the injection treatment prior to surgery to acquaint the patient with the numbness resulting from such an operation.
Wilfred Harris in 1922 (26) described the effect of alcohol on nervous tissue. "Strong alcohol (96%) being a tissue fixative coagulates the albuminous elements of the nerve fibers and dissolves the fatty sheath of Schwann. Degeneration downward of the nerve then results from the point of injection. Regeneration occurs in the ordinary course and may be more or less complete in two years."

There has been no permanent cure reported from alcohol injection, and it should be offered as a means of temporary relief of pain for patients who are unwilling or unable to have section of the sensory root done for permanent relief.

Grant, F. C. (29) used peripheral block by the use of alcohol as a diagnostic aide, and has since the advent of improved surgical technique been somewhat neglected. The two branches injected are the second and third, and to be of any value the alcohol must be injected into the nerve sheath.

It is of particular value in case of early tic, the patient usually shys away from any operative procedure, and then is when the alcohol injections are of value.

Its disadvantages are that it is a painful procedure, the nerve may not be successfully blocked, and occasionally a temporary external rectus or facial polsy may result.
Ball, C. R. (3). The results of alcohol injection are paresthesia over area of nerve injected, numbness, burning, creeping, crawling, pulling, and drawing sensations, and occasionally no relief of symptoms is offered by this method.

The trigger zones are the only place in the whole sensory area of the fifth which show any objective symptoms. Outside of this zone sensory symptoms to objective methods of examination seem perfectly normal. In this zone sensation to touch and pin prick is intensely hyperesthetic. The slightest touch or movement or even the suggestion, releases a severe spasm of pain. One of the peculiarities of this zone is that is may lie in the distribution of the third branch and all the pain be in the second and first.

Injection of the first and second division with not give relief, but if the branch supplying the trigger zone is sought out and injected relief is obtained.

These trigger zones may change position and may locate themselves along the distribution of the other two branches. Then again these trigger zones may disappear as completely and suddenly as they came, and then as if by magic the spasmodic pain stops. The behavior of these trigger zones would suggest the functional nature of the disease and indicate its systemic or central character.
True tic douloureux may not only change its location on the same side of the face but also change from side to side.

The fact that tic douloureux usually occurs in the latter decades, does not rule out its functional character, for if a careful history is taken on these patients, is that functional condition occurred in these patients in their early years, but in the mind of the physician or patient have not been associated with the development of true tic douloureux.

Because of the belief of functional nervous conditions, and having a feeling that genuine tic douloureux belongs in this category, a form of treatment was selected which has given some success in many functional nervous cases. This is the so-called fever therapy.

Milk was used as the agent to produce the fever, injected intramuscularly into the buttocks, four days in succession. First day 5 c.c. and increasing it five c.c. each day or varying the amount according to the reaction. In case this did not work, triple typhoid was used as the foreign protein.

The first injection almost invariable increased the pain, and even during the height of the reaction in the fourth injection the tic pain was present in some cases. During the treatment sedatives were given to make the patient comfortable. This was tried on ten
patients who had tic of long standing and had previous alcohol injections. Of the ten who received the milk treatment, nine have remained pain free except the first patient who received only one injection. Before patients were discharged they were subjected to all types of stimulation, and no trigger zones where located, and those that had previously existed had disappeared.

Hansley, V. (1891) (36). The operation recommended and carried out are of four types. 1. "Nerve stretching; 2. Nerve division; 3. The excision of part of the nerve; 4. Nerve avulsion." Another way may be mentioned is by thrusting a red hot iron wire into the foramen of exit of the nerve, but because of its barbariousness, and since other methods have proven better it has not come into general use.

How is the operation supposed to act? Bell suggests that section of the nerve produced an alternative and tonci effect on the nervous system. Erb agrees with Bell in thinking that the "strong peripheral stimulus of the operation is the cause of the disappearance of the neuralgia. Tripier (1879) regards the condition as probably due to some central change, and that temporary relief is obtained by operation. Carnochan, attaches great importance to Meckels ganglion,
and a essential in his operation was the removal of this. Horsley believes that the trouble is peripheral and if the nerves are severed as they emerge from the skull relief will be obtained.

It has been stated by Huter that experiments show that not less than five inches of the nerve must be removed to prevent reunion with certainty.

Frank, L. W. (27). In doing an avulsion of the nerve make incision over entrance of peripheral nerve from the skull and thoroughly and gradually "twisting it out". The relief from this is only temporary but longer than that obtained by alcohol injection. The nerves will regenerate in time so it is advisable to plug up the foramen from which they imerge.

Extraction of teeth has led to some relief when a tooth happens to be the trigger zone, but the attacks recur and the patient is still minus his or her teeth.

Wagner (1869) (46) reported 135 cases in which he had done peripheral neuroectomies, followed by relief for a couple of months, then the condition returned and the procedure had to be repeated. Surgical neuroectomies distal to the ganglion were being carried out and it was not until the early '90 that there was a direct attempt upon the gasserian ganglion. The mortality was high but they did learn that such procedures gave relief. They attempted at this time to inject the ganglion with alcohol and Pusey (1911)
succeeded. In the same year Taptas injected it thru the foramen ovale and in 1912-1913 Harris and Hartel developed a special technique for injection of the ganglion.

Mears, J. Ewing 1884 (21) first proposed removal of the ganglion and with the previous development of ether anesthesia by Lord Lister in 1846 (46) and his contributions to operative surgery, the problem was attacked with more confidence.

Trousseau (1868) (46) sums up his experiences with the treatment as he knew stating "Even now, after more than 36 years of practice, I have never known it to be cured in a single case."

Rose, 1890 (46) was the first upon the suggestion of means to attempt resection of the ganglion, he devised the pterygoid rout, and by means of a curet to destroy the ganglion. In the same year Alexander of Chicago devised a technique of approach through the pterygoid fossa and this was later used by Poiriers and Cushing.

Rose (1890) (54) states that his first attempt to remove the ganglion was successful and offers a new field for the treatment of trigeminal neuralgia, which is unrelieved by nerve stretching, avulsion or injection.
Horsley, Victor (1891) (46) attempted an intracranial approach to avulse the root of the ganglion. He believed that it would relieve the pain and prevent regeneration.

Hartley and Krause (1890) (46) working independently of each, developed a technic and successfully resected the ganglion with a complete cure, the first to be reported. The mortality was about 22%. In order to lower this partial resection of the ganglia tried and in 1898 Spiller suggested that section of the sensory root would not regenerate and still give relief of pain.

Hutchinson (1898) (32) performed the operation of the removal of the gasserian ganglia for pain with success according to the Hartley-Krause method, and he is of the opinion that this most radical procedure will replace the more conservative types of surgery, that of removing the extra cranial segments of the fifth, for the more radical intracranial procedures.

On the strength of Spillers (46) suggestion Frazier planned and successfully carried out an extradural procedure. This became the vogue and the mortality was lessened. The entire sensory root was divided including its molar portion.
Spiller in 1901 (25) proposed the section of the sensory root rather than resection of the ganglion. There have been many refinements. Chiefly the conservation of the motor root and preservation of the ophthalmic division, thus eliminating the danger of a trachic keratitis. Only occasionally is it necessary to sacrifice this root.

Flothow, P. G. (1930) (28) states that surgical division of the sensory root gives almost one hundred percent relief from pain. In cases where this procedure does not give relief cervical sympathectomy has been tried and proven itself to successfully relieve the pain.

It has been observed that in a good many cases the second and third branches were the ones involved so Frazier (1915) (46) in his surgery began sparing the ophthalmic division and practically eliminated the eye complications.

More careful study of the origin of the motor root and it was soon identified at operation and soon spared.

Patrick (1912) (6) pointed out that "no procedure is a cure except the removal of the sensory portion of the gasserian ganglion."

(21) Between the years of 1891 and 1921 the peripheral operations of the terminal branches of the
of the several divisions has been abandoned and alcoholic injections have taken their place. During the same period operations upon the gasserian ganglion with trivial exception have been replaced with operations upon its sensory root.

Dandy, W. E. (1929) (16) presented a new operation and the greatest advance in trigeminal surgery since its advent, and that is his occipital incision, and cerebellar approach to the nerve. It is bloodless, the sensory and motor root can be easily separated at the pons, and it makes possible the severing of both sensory roots in case of bilateral, tic and be sure that you are not destroying the motor function.

Some advantages obtained by Dandy in the use of his operation are:

1. "The sensory root can be divided either partially or totally. At first total division of the sensory root was performed. Gradually it was found that by partial section of the root the pain was cured and at the same time the sensation of the entire domain of the fifth is little disturbed.

2. Partial section of the sensory root at the pons is advocated exclusively.

3. The advantages of partial section of the sensory root by the root here proposed are:

   a. Immediate postoperative corneal disturbances uniformly absent.
and a essential in his operation was the removal of this. Morsley believes that the trouble is peripheral and if the nerves are severed as they emerge from the skull relief will be obtained.

4. The operation is, in effect essentially that of cordotomy, in that only pain fibers are sacrificed and all forms of sensation retained.

5. Observations herein described deny the hypothesis that the peripheral branches of the trigeminus are accurately represented by subdivisions of the sensory root.

6. Lame postoperative sensory observations suggest that there are separate nerve fibers for various types of sensation.

7. Pain fibers appear to travel separately and to be located exclusively in the posterior part of the sensory root. (in cross section)

8. Even when the sensory root is totally divided varying degrees of sensation are retained in the face. At times, this sensation approaches the normal. This is due to the fact that accessory branches usually accompany the motor root and later join the sensory root. When accessory branches are absent, anesthesia of the face is complete.

9. The accessory branches of the sensory root apparently never contain pain fibers, nor are pain fibers
brought to them by anastomoses with the fibers of the sensory root.

10. Bilateral tic douloureux can be cured at a single operation by this method.

11. Occasionally tumors of the cerebello-pontile angle cause tic douloureux, by this approach they would be exposed. The chance of successful removal are enhanced because the tumor is found earlier. By temporal route these tumors would be missed.

12. When malignant tumors invade the gasserian ganglion, relief cannot be obtained by dividing the sensory root by the temporal rout. The cerebellar route is indispensable in such cases.

13. Lacrimation continues after division of the fifth nerve.

14. Facial paralysis results in the temporal approach because the geniculate ganglion is injured.

There are few contraindications (25) against operation up to the age of the 80th year. After that the life expectancy is not so long and usually a few alcohol injections will usually carry the patient until life terminates. The major operation is dangerous only in the extent that the surgeon never knows what he will find, or the difficulties he will run into, and in this case experience is the best guide as what to do.
McKechnie, R. E. (1933) (45) in obstinate cases removed the superior sympathetic ganglion. This often gave relief from symptoms even after operations upon the gasserian ganglion had failed. It is a simple operation, with no shock necessitates but a short stay in the hospital.

Kleth, V. (49) in case of tic where the trouble is chiefly confined to the ophthalmic division cervical sympathectomy has proven to be a valuable method of treatment, although the relief is some what slow in developing.

Cervical sympathectomy in conjunction with alcohol injection of the branches offers a very good form of treatment. In cases where such treatment is indicated relapses are common. It is a good procedure to try when removal of the gasserian ganglion fails to give relief in some cases.


1. "Excision or avulsion of the nerve gives only temporary relief running from six weeks to four months, although some cases are permanently relieved. This operation is seldom justified as alcohol injection will produce the same results, without the surgical procedure."
2. Alcohol injection of the second and third divisions as they leave the skull. Injection is to be performed only on these divisions. If nerve is hit, immediate relief results, throughout division of nerve injected. It is the operation of choice for relief of pain when intercranial injection or operation is refused.

3. Division of sensory root to ganglion (Spiller-Frazier operation) with this surgical procedure there is usually immediate and permanent relief of pain.

4. Alcohol injection of the ganglion is a moderately difficult procedure and if pain is relieved the ganglion has been reached.

Nerves outside the skull have the sheath of schwann, while the sensory root does not have, and nerves that have the sheath regenerate while those without do not, so if the sensory root is destroyed by scalpel or chemical means the relief is usually permanent and complete.

The whole story (46) of trigeminal surgery has been the evolution of surgical technic. The development of special instrument, more exact knowledge of nervous anatomy and experimental work done on nerve regeneration.
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