

THE SURGICAL TREATMENT OF TRIGEMINAL NEURALGIA*

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IT is the purpose of this paper to present some observations regarding the operative procedure of section of the sensory root for Trigeminal Neuralgia (Tic Douloureux). First, however, the symptomatology, differential diagnosis, and rôle of deep alcohol injections will be briefly reviewed. This can partly be accomplished by giving somewhat in detail the history of a typical case.

The patient, age twenty-eight, had a history which extended back five years, but despite this length of time, she remembered clearly her first stab of pain. This was sudden, momentary and knife-like through her right upper jaw, and came on without apparent cause while she was out for a walk. She stopped, cried out, and grasped her cheek. The pain was over in an instant. A few days later there was a similar recurrence. For several weeks the attacks became so frequent that she was completely disabled, the periods of relief between the stabs of pain being only a matter of minutes. She learned that various stimuli, such as eating, talking and brushing her teeth, were very apt to bring on a spasm. Considerable difficulty was experienced in getting to sleep; however, once asleep, she was never awakened by pain. The first spasms of pain which involved only the right second division, covered a period of several weeks. This period was followed by relief for some months when the malady returned, persisted for some months, and again was followed by a period of relief. In this manner her attacks of pain kept coming and going from 1919 to 1923, during which time all her upper teeth were extracted, tonsils removed, various nasal operations were performed and drugs of all sorts prescribed.

During the early part of 1923 a deep alcohol injection of the second division was carried out and complete relief was obtained for nine months. The pain then recommenced, but this time there were some additional stabs

through the first division up over the forehead. Again an alcohol injection of the second division was carried out and almost complete relief was obtained for fourteen months. A few weeks ago, the pain returned with increased violence, the patient was able to take only liquids, and was afraid to speak or laugh. While taking her history, one was able to observe two spasms of pain, which brought about contorsion of the right side of the face and caused her to cry out. She described these spasms of pain as being like an electric shock, commencing in her right upper lid and travelling upwards through her eye over the forehead.

This story is so typical, that, at the risk of being tedious, it has been given in full. In going over the histories of these cases, one is impressed by their similarity. The essential feature is the type of pain, which is excruciating, sudden, momentary, with varying periods of complete relief. It may radiate through any one or all of the three divisions of the trigeminal nerve, most rarely the first. It should be noted that this patient, despite her typical story, has had all her teeth extracted, the tonsils removed and several nasal operations performed. No case suffering from major trigeminal neuralgia is benefited in the least by any such procedures.

It is interesting to note that this patient was never wakened from her sleep—the usual story in these cases—and this is most likely accounted for by the complete rest of the parts and the absence of stimuli during sleep.

In such an outstanding case as quoted, there should be no question even from the beginning regarding the diagnosis, but in a less typical case, one must be on guard and consider the following painful disorders:

- 1.—Neuralgias accredited to the sphenopalatine ganglion, the so-called Sluder's neuralgia.
- 2.—The neuralgias accredited to the geniculate ganglion of the facial nerve.
- 3.—Post-zoster neuralgias (trigeminal and geniculate).
- 4.—Painful convulsive tic.

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5.—The minor trigeminal neuralgias, due to trauma, teeth, sinus infection, etc.

6.—Neuralgias due to tumours.

7.—Glosso-pharyngeal neuralgia.

It is beyond the scope of this paper to discuss the differential diagnosis of these painful conditions in full.

The treatment of trigeminal neuralgia should be considered under two headings: (1) The rôle of deep alcohol injections; (2) section of the sensory root.

The rôle of deep alcohol injections.—A full discussion of this important form of treatment would necessitate a separate paper. Deep extra-cranial injection of the first division is not possible on anatomical grounds. Injection of the second and third divisions at their exits from the skull is fairly easily carried out, with a reasonable expectation of relief even up to three years. Each succeeding injection, however, will be more difficult because of the resultant scar tissue formation. To carry out the injection, one must have a working knowledge of the deep anatomy of the base of the skull. A fine needle marked off at the six centimeter point, for orientation as to depth, is introduced. One only knows that one has struck the nerve by producing the typical radiating pain—hence the necessity of not having your patient under an anæsthetic. Local anæsthesia of skin, however, is desirable. Good co-operation on the part of the patient is essential, although if the patient be suffering from a real tic, the pain produced by the needle striking the nerve is no new sensation. Having hit the nerve, two centimeters of 80 per cent. alcohol are introduced and, in a few moments, there will be complete anæsthesia over the area supplied by the division. One must be very optimistic indeed to believe that he can do more than inject alcohol in the region of the nerve, when the patient is under an anæsthetic; only occasionally may a good injection be obtained in this way. There are further objections to the use of a general anæsthetic and two complications, which are easily recognized, if the patient is not anæsthetized may be mentioned. (1) Injection into the Eustachian tube; (2) injection into the sixth or even the third nerve.

Again the importance of being thoroughly orientated before injecting the alcohol must be mentioned. The only true guide is to hit the nerve with the needle and produce the typical spasm of radiating pain.

Now just a word about the injection of the Gasserian ganglion through the foramen ovale. It is difficult to understand how anyone can have sufficient confidence in this technique to believe himself capable of always injecting the ganglion and not entering the sub-arachnoid space; this complication has occurred many times with results that are deplorable. One case on record had a complete paralysis of almost all the cranial nerves. Dr. Cushing¹ reports a case having such extreme vertigo six months after a ganglion injection that she could not hold up her head. Also judging from the literature, severe eye lesions are frequent, as after the old operation of removal of the ganglion.

In brief, this subject may be summed up by quoting a few conclusions from a paper by Cushing² in 1920:—“deep extracranial injections of alcohol into the maxillary and mandibular nerve trunks, near their foramina of exit from the skull, have completely superseded peripheral neurectomies. In neuralgias limited to one of the two lower divisions, alcohol injections represent unquestionably the treatment of choice. They are sometimes useful furthermore, in determining in doubtful cases whether the syndrome is a true neuralgia of the tic douloureux type or one of the peculiar and rare pseudoneuralgias not amenable to relief either by injections or operations. Also, they give the patient some warning as to what the numbness resulting from a sensory root division may amount to. With such perfect and permanent results as may be secured to-day by a trigeminal sensory root section the prolonged and repeated use of injection of alcohol in refractory cases or in those in which more than one division or the first be involved is to be deplored.”

Operative Treatment.—Unfortunately it is far from common knowledge amongst the laity and our own profession that the mortality of the operation is very low—less than 1 per cent with experienced operators—despite the fact that many patients are over sixty-five years of age. Advances have been very rapid and we are no longer dealing with a mortality, which in the past, ranged from ten to twenty-five per cent. Disfiguring post-operative scars and severe eye complications are also no longer to be feared.

Historical Sketch.—A brief historical sketch of the operation is very interesting and fills one with admiration and respect for those who have developed our present-day technique. Who now

would have the courage to attack the Gasserian ganglion by removing the upper jaw and trephining the base of the skull? In 1890, Rose³ the first operator to successfully remove the ganglion, followed this route. Shortly before this, Sir Victor Horsley,⁴ who felt from his dissections that the ganglion could never be removed without tearing the wall of the cavernous sinus, attacked the sensory root and not the ganglion by making a large lateral bone flap, opening the dura and elevating the brain stem. He then cut the root, but the patient unfortunately died of shock.

It is really unfair to quote Rose as removing the superior maxilla to get at the ganglion. The truth of the matter was that the patient refused to have anything done unless her jaw was removed, as this appeared to her to be the real seat of the trouble. The willingness to submit to such an operation shows if nothing else, the possible severity of this malady which in the past has frequently led its sufferers to suicide.

In subsequent operations, Rose and other operators adopted the pterygoid route; one which gave a very limited exposure and involved a very difficult dissection. Shortly after Rose reported his first cases, two surgeons, Hartley and Krause independently practised the turning down of a temporal flap. The dura was elevated and the ganglion approached along the floor of the middle fossa. Various modifications of this Hartley-Krause route were then advocated and practised. The incision was modified so that the superior branch of the facial nerve was not injured, the zygomatic process along with varying portions of the skull resected so as to give a lower exposure. The principle of this method of approach, namely extra-dural along the floor of the middle fossa, has withstood the test of time and is now, though much simplified, universally adopted.

From Rose's first operation in 1890 until 1901, all operative procedures with the exception of Horsley's⁴ one case, were planned to remove the ganglion. Because of its anatomical relations, this was a very difficult and bloody procedure and was followed, as is injection of the ganglion itself, by frequent severe eye complications.

It seems strange that, not until 1898, do we again find Spiller⁵ of Philadelphia suggesting that the sensory root behind the ganglion be cut.

He and Frazier carried out experimental work to show that there is no central regeneration of the nerve, although this point had been fairly definitely settled some years previously by Sherrington.⁶ Furthermore, Sir Victor Horsley had conceived the operation, but unfortunately chose a route which necessitated so much trauma, that the patient did not survive.

Frazier⁷ in 1901, successfully operated on a patient by section of the sensory root just behind the ganglion. The patient obtained complete relief, which persisted. Since then, this Frazier-Spiller operation has been universally adopted. Recently Frazier⁷ has modified his technique in dealing with cases that have not the first division involved. In certain of these cases he has purposely sectioned only the outer two-thirds of the root leaving the fibres to the first division. This has a very definite advantage as it leaves the sensory supply of the eye undisturbed. If later the first division becomes involved it would be a simple matter to complete the section. This refinement of technique appeals to one as being well worth while and should be adopted in properly selected cases. Recently we have had the opportunity of successfully carrying out this procedure on a blacksmith. His first division was not involved and one was anxious to leave the sensation in his eyeball intact.

The position of the patient is important. My personal experience is based on twenty-three operations during the past two and a half years. There has been no mortality. Eight of these were performed with the patient recumbent. After visiting Adson's Clinic this method was abandoned and the operation is now carried out with the patient sitting up. During the past year this technique has been carried out on fifteen cases, and the operation is found to be much simplified by this position. With the patient recumbent there is constant flooding of the field with blood rendering the dissection often extremely difficult so that one was always thankful when the procedure was over.

Technique.—The following photographs and drawings illustrate the technique now in use. The necessary area of the head is shaved just before operation, and no attempt is made to sterilize the skin until just before the drapes are applied, when a thorough cleansing with alternate bichloride and alcohol sponges is carried out.

General anaesthesia is preferred by the writer although the first stages of the operation including the removal of the bone, can be easily carried out by local infiltration with 1 per cent. novocaine. Since shock, either at operation or post-operatively, has not been a complication so far even in our oldest patients, several of whom have been past seventy, we doubt the wisdom of subjecting our patients to this extra mental strain for the sake of saving one half-hour of general anaesthesia, especially when experienced administrators are available. Ether anaesthesia by the intra-tracheal or intra-pharyngeal technique is employed; the patient preferably being anaesthetized in the semi-sitting posture and is then gradually raised to the sitting position, to avoid the fall in blood pressure that sometimes occurs when a sudden change from a dorsal to a sitting position is effected. Nitrous oxide oxygen sequence is to be preferred to the ethyl-chloride ether sequence when this position is used. Nitrous oxide oxygen might be employed throughout, but we have felt that since shock does not seem to complicate the picture, that it would be unwise to risk any possible interference with the operative field by the mask or head straps occasioned by its use.

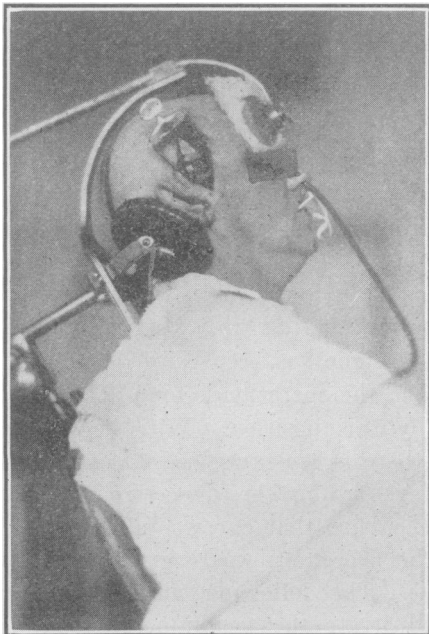


FIG. 1.

In Fig. 1 the drapes have been removed and show the patient in the sitting position. The head is held in position by a modified dental head rest adapted to the tipped-up

end of an operating table. The table as a whole can be lowered or raised so that the operator may work with the field at a comfortable level. The position of the vertical split-temporal muscle incision is shown. Retraction is maintained by an ordinary mastoid retractor. The incision has been carried down to the zygomatic arch. A short, low anterior cross incision in the muscle may be necessary to get better exposure in the lower part of the field. A burr hole is made through the bone and enlarged so that the subsequent steps are carried out through a somewhat square opening, $1\frac{1}{2} \times 1\frac{1}{2}$ inches, with its lower border at the level of the zygomatic arch. A branch of the middle meningeal artery is often injured while removing the bone. If the bleeding is troublesome and not conveniently controlled by pressure made with a flat retractor, it is best to open the dura carefully and then pass a ligature around the vessel or clip it. If one passes a ligature without opening the dura, extreme care must be used to avoid injury to an underlying cortical vessel. For the most part this is not necessary, the bone can be rapidly rongeured away and then the upward pressure of the flat retractor, used in the subsequent steps will control bleeding from above. Bleeding from the bone edge is controlled with bone wax.

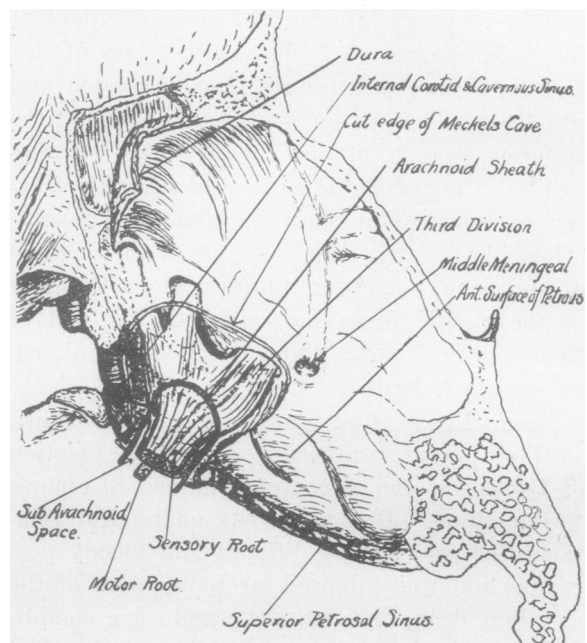


FIG. 2

Before proceeding with the subsequent steps let us refer to Fig. 2. Here we are looking down on the floor of the right middle fossa

The dura is intact, with the exception of the roof of Meckel's cave, which has been cut away. The manner in which the dura passes deeply to the ganglion to form the floor of the cave is thus made apparent. The sheath of the arachnoid and its attachment to the ganglion is shown. The sensory and motor roots and the upper part of the ganglion are surrounded by cerebro-spinal fluid of the subarachnoid space. The superior petrosal sinus passes from the cavernous sinus across the superior surface of the sensory root. The close relationship of the mesial portion of the ganglion to the cavernous sinus and its contents are apparent. With these anatomical points in mind, let us proceed with the operation in a right-sided case. The dura is dissected from the floor of the middle fossa and elevated with an electric-lighted retractor. The only point of orientation at this stage is to keep to the lowest portion of the floor and go straight in. The middle meningeal artery at the foramen spinosum will soon appear. Certain difficulties may arise in this dissection. The dura may be very thin and accidentally opened, necessitating careful covering of the brain to prevent injury to the cortex while manipulating the retractor. The floor may be exceptionally irregular, making the separation of the dura difficult and thus the middle meningeal artery may be torn through before it can be brought clearly into view. When this occurs the field is flooded with blood until the foramen spinosum is blocked with wax. This has to be done more or less blindly in the depth of the field, and one may have to repeat the manœuvre many times before the dissection is carried past the foramen spinosum, which can now be seen and more accurately blocked with wax. Apart from the middle meningeal bleeding there may be troublesome oozing all along, which can be best controlled with well placed small pads of cotton and the use of a sucker.

In most cases, it is possible to clearly define the middle meningeal artery and control it with a silver clip or ligature. The artery is then divided. A little deeper dissection, somewhat forward, will quickly bring the third division at the foramen ovale into view. One is then thoroughly orientated.

Fig. 3 has been made at this stage. The foramen spinosum and foramen ovale do not always bear the same relationship to one another. I well remember a case in which they were apparently both together or the small meningeal

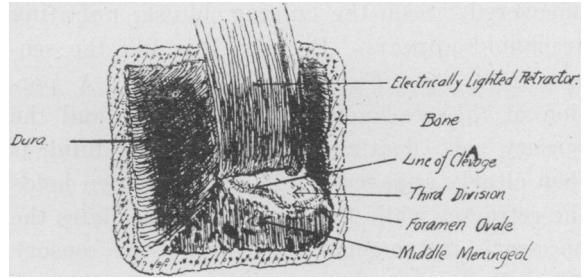


FIG. 3

which normally accompanies the third division had taken on the function of the middle meningeal. The patient had had many alcohol injections and the third division was small and embedded in fibrous tissue. The third division along with the middle meningeal was cut through without appreciating the fact. Dissection was then carried on to find the nerve which had already been cut. A glance at the anatomical sketch will show that if one gets through the third division, further dissection carries one deep to the ganglion and up to the cavernous sinus, and a very bloody path it is, as the ganglion derives its blood supply from its under side. Fortunately I was finally able to orientate myself and complete the operation, not by sectioning the sensory root, but by division of the second division at the foramen rotundum. This has given complete relief for two years as the patient did not have involvement of the first division. Section of the sensory root will eventually have to be performed on this patient, when the second and third division grow down again.

The third division is now followed upward and backward. This necessitates the separation of the roof of Meckel's cave from the third division and the ganglion, and a correct line of cleavage must be defined along the posterior border of the ganglion and between the third and second divisions.

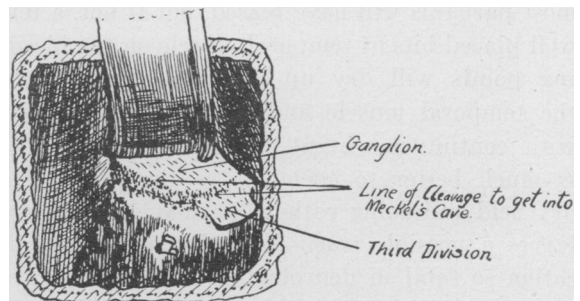


FIG. 4

Fig. 4 shows the point at which the line of cleavage has been made, and also the whole of the third division and part of the ganglion

uncovered. Soon the bulging, bluish, pulsating arachnoid appears. Beneath this lies the sensory root (See Fig. 2 and Fig. 5). A portion of the arachnoid is then opened, and the sensory root, floating in cerebro-spinal fluid, is then clearly apparent. The assistant then holds the retractor while the operator manipulates the necessary instruments to separate the sensory from the motor root.

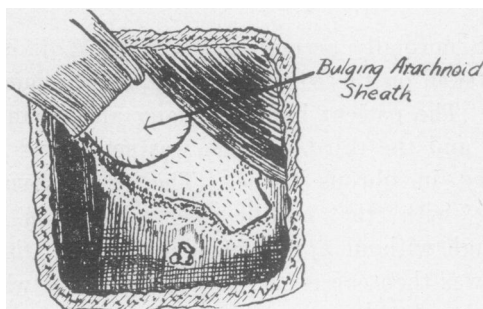


FIG. 5

The sensory root is sectioned and turned down. The motor root will then be seen to be passing through a separate opening in the posterior wall of Meckel's cave (See Fig. 6). Electrical stimulation is not necessary for identification of the motor root.

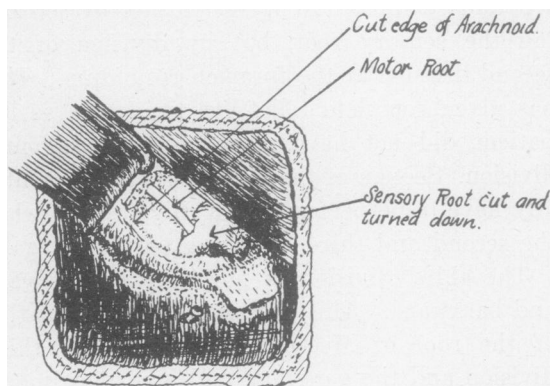


FIG. 6

This practically completes the operation. All oozing must be carefully controlled. For the most part this will have ceased, but if not, a few well placed bits of temporal muscle on the bleeding points will dry up the field. Closure of the temporal muscle and fascia is carried out with continuous catgut, without drainage. It is much better to spend extra time getting a dry field and doing without drainage. Drainage leaves a possible track for infection, a complication so fatal in neurological surgery. A protective watch-glass shield is held in position over the eye by adhesive and should be worn for several days. Nurses are warned to wipe away any secretion from the eye without touching the cornea, which is of course insensitive. Later,

when the wearing of this shield is discontinued, the patient is warned against touching the cornea and advised to wash the face in front of a mirror. Goggles should be worn when motor-ing. If the eye should become inflamed, the wearing of the air-tight glass shield for forty-eight hours will generally clear it up. Especially must the patient be warned against allowing anyone to place the ordinary eye pad over the eye, for if this is done they will almost surely open the lid and abrade the insensitive cornea. All of these directions should be carefully explained to the patient and also supplied in writing. With reasonable care, eye complications do not occur.

Before operation, it is well to explain clearly to the patient the disadvantages of the operation. They are as follows:—

1.—Total and permanent loss of sensation over the whole side of the face, unless the case be a suitable one to leave part or all of the first division fibres.

2.—The necessity of a moderate amount of care to protect the eye from particles of dust. This of course will not apply if the first division fibres are left.

3.—A temporary facial weakness occurs in one in thirty cases. The exact cause of this weakness is unknown. It occurs in every clinic. We have had one case. This weakness was complete immediately after the operation and still persists, after three months, with very little improvement.

Summary

1.—Section of the sensory root of the fifth nerve is described and illustrated in detail.

2.—The diagnosis, symptomatology and rôle of deep alcohol injections is briefly reviewed.

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