

## PHYSIOLOGIC EXTIRPATION OF THE GANGLION OF GASSER.

FURTHER REPORT ON DIVISION OF THE SENSORY ROOT FOR TIC DOULOUREUX, BASED ON THE OBSERVATIONS OF FOUR CASES.\*

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### REMARKS BY DR. FRAZIER.

In June, 1901, three years ago, I reported to the Section on Surgery of the American Medical Association then in session at St. Paul, the results of a series of experiments on dogs conducted by Dr. Spiller and myself, with a view toward determining the feasibility of dividing the sensory root of the gasserian ganglion for the relief of tic douloureux.

### RESUME OF EXPERIMENTAL WORK.

These experiments consisted in carrying out this operation on a number of dogs and subjecting the structures removed several months later to a rigid histologic examination to determine whether regeneration of the sensory root after simple division could occur. The results of these investigations admitted of but one interpretation, namely, that there was not the slightest evidence of regeneration within the central nervous system. More recently,<sup>1</sup> Dr. Spiller and myself pursued this line of investigation in a series of experiments on the sensory roots of the spinal ganglia with equally positive results.

Having established by experimentation in lower animals beyond a peradventure of doubt the inability of the sensory root to regenerate at least within the central nervous system, it only remained to obtain equally positive results in the human subject before any substantial claims for the operation as a rational, practical and "tried-out" procedure could be made. These we present to-day as a result of our experiments with four cases; all have remained free from recurrence.

### ADVANTAGES OF THIS OVER OTHER PROCEDURES.

Extraction of the ganglion. Certain theoretical claims were advanced in favor of the operation, and these have been substantiated by our clinical experience.

1. *Control of Hemorrhage.*—It minimizes the amount of hemorrhage. No one can speak the truth and say that hemorrhage is not a troublesome feature. Hemorrhage from the middle meningeal artery is of little or no moment, and it can be controlled easily whether the vessel be injured as it courses along the temporal bone or at the foramen spinosum. On the contrary, hemorrhage from emissary veins is distinctly troublesome. The greater the number and firmness of dural attachments, the greater will be the hemorrhage from this source, and the nearer we approach the ganglion the firmer the adherence and the freer the bleeding. Inasmuch as the ganglion receives its greatest blood supply from below, surgeons are advised to put off elevation of the ganglion to the last. To divide the sen-

sory root the base of the ganglion is left undisturbed and this cause of free and persistent bleeding avoided.

The only other source of hemorrhage worthy of consideration is the cavernous sinus. Injury to this sinus has caused hemorrhage, if not serious and alarming, at least necessitating suspension of the operation for a day or more. This vascular channel being in intimate relation with the internal aspect of the ganglion, is exposed to danger once the operator begins to free it from the ganglion. Confining, as we do in practicing division of the sensory root, our manipulations to the root itself and to the posterior aspect of the ganglion, work at the point of greatest safety, insofar as the sinus is concerned, and need never give it a thought.

2. *Simple Technic.*—Its execution is comparatively simple. It goes without saying that the exposure of the ganglion is by far less difficult than its extraction. Once the ganglion is exposed, we have made all the preparations necessary for the division of the sensory root; thus this operation is complete before the difficulties common to the extraction of the ganglion have been approached.

3. *Avoidance of Injury to Adjacent Structures.*—The cavernous sinus is not exposed to injury. The abducens is in such intimate relation with the ophthalmic branch that division of one is almost impossible without division of the other. In the extirpation of the ganglion it is a matter of great difficulty to preserve this cranial nerve intact. The motor root is always destroyed in extraction of the ganglion; whereas, in division of the sensory root, the motor root may be preserved intact.

4. *Reduction in the Rate of Mortality.*—If the troublesome difficult features attending operation for the extraction of the ganglion are, to a great extent, eliminated, there should be an appreciable reduction in the time required to complete the operation, and it is only reasonable to predict that the operation, which is more economical as to time and attended with considerably less hemorrhage, will be attended with a lower mortality.

### TECHNIC.

This phase of the subject has been treated fully in previous papers.<sup>2</sup> The approach to the ganglion by the usual Hartley-Krause method, the temporary or permanent resection of the zygomatic process, the exposure of the foramina ovale and rotundum as guides to the ganglion; an incision in the dura propria from one foramen to the other; the reflection of dura propria from the superior and posterior aspect of the ganglion revealing the sensory root; picking up of the root on blunt tenaculum and division of same completes the operation.<sup>3</sup>

2. University of Pennsylvania Med. Bul., December, 1901; Philadelphia Med. Jour., Oct. 25, 1902.

3. Considerable importance has been attached to what has been called the intra-arterial route and the difficulties attached to injury to the middle meningeal artery grossly exaggerated. One familiar with the great variation in the course of the middle meningeal artery and its relation to the temporal and frontal bone realizes at once the futility of attempting to establish a point below which one can operate always with the assurance that the vessel will not be injured. The danger of injuring the middle meningeal vessel in opening the skull is due to the fact that the vessel sometimes runs in a bony canal, sometimes in a deep channel. When the fragment of bone is removed the vessel is lacerated. Sometimes there is no canal at all, usually the canal begins sufficiently high to escape injury; exceptionally, however, the canal begins so far down that it would be impossible to make an opening large enough to enable one to carry out the necessary manipulations on the ganglion by the so-called intra-arterial route. Common sense prompts one to make the opening as near the base of the skull as possible, not especially to avoid the artery, but in order to reduce to a minimum the distance from the margin of the skull to the ganglion and to make the opening only as large as the manipulation may require. No other directions to the operator are necessary; he avoids injuring the artery if he can, and if he can not, it is a matter of no difficulty to control the hemorrhage.

\* Read at the Fifty-fifth Annual Session of the American Medical Association, in the Section on Surgery and Anatomy, and approved for publication by the Executive Committee: Drs. DeForest Willard, Charles A. Powers and J. E. Moore.

1. University of Pennsylvania Med. Bul., June, 1903, p. 126.

## DIFFICULTIES ATTENDING THE OPERATION.

An objection has been made to the operation we advise for the relief of tic douloureux, viz., that the sensory root can not always be exposed, and that in such a case resection of this root would be impossible. Dr. Spiller thinks it is extremely probable that resection of the posterior part of the gasserian ganglion would have the same effect as resection of the sensory root. The object we strive for is the division of the central nerve processes which arise in the cells of the gasserian ganglion. Many of the cells that send processes into the sensory root are cut off from this root by a resection of the posterior part of the ganglion, and the effect in the permanent relief from pain would probably be the same as though the sensory root were divided. If, therefore, there is any difficulty in exposing or recognizing the sensory root Spiller recommends a resection of the posterior part of the ganglion, believing that it would be as effective as a resection of the sensory root.

## PHYSIOLOGIC EXTIRPATION OF THE GASSERIAN GANGLION.

Up to this time the claims which have been made for division of the sensory root have been based altogether on the results of our own experimental and clinical evidence. It might be well at this juncture to introduce the evidence of an impartial critic whose judgment and opinions in matters pertaining to the physiology, pathology and anatomy of the nervous system are held in great respect. Van Gehuchten has published recently a most instructive and interesting paper on the surgical treatment of trifacial neuralgia,<sup>4</sup> and in this article he discusses somewhat at length the effects of division of the sensory root. Owing to the fact that he believes this operation to be as radical in effect as extirpation of the ganglion, he has styled the former not inappropriately the "physiologic extirpation of the ganglion," and regards it as both less dangerous and more complete than the operation of Krause.

His observations and conclusions on the question of regeneration or degeneration of the sensory root confirm absolutely our own. Every fiber of the central nervous system, he says, attacked by secondary degeneration is a fiber inevitably lost. "The nerve fibers of the central nervous system interrupted at any part never regenerate. The section of the large root of the trigeminal nerve is equivalent, then, at least as regards its effects on the bulbo-spinal root, to the destruction or extirpation of the gasserian ganglion itself. Whether the cause of the trifacial neuralgia resides in the semilunar ganglion, or in one or the other of the three peripheral nerves, at the moment we interrupt completely all communication between the ganglion and cerebrospinal axis, we destroy inevitably the route by which painful impressions are conveyed to consciousness.

"The section of the large root of the trigeminal nerve, even though it does not constitute an anatomic extirpation of the semilunar ganglion, is equivalent, then, to a true physiologic extirpation, and is the only one which is of importance in point of view of treatment of trifacial neuralgia.

"This physiologic extirpation is not only more complete and easier to accomplish than the tearing out of the ganglion recommended by surgeons, but it has an advantage over this mode of operation which is not to be despised. It leaves intact the connections of the ganglion with the peripheral organs."

That the operation on the root is much more simple than the extirpation of the ganglion might be inferred from the fact that many surgeons, among them Poirier, Horsley and Lauwers, recommend tearing out the root as a preliminary measure to extirpating the ganglion. If the exposure of the root were a matter of any great difficulty, this step of the operation naturally would have been postponed until the last when the ganglion was entirely freed from its attachments.

It has been said that the suggestion made by Dr. Spiller, in 1898, of treating tic douloureux by division of the sensory root was not original; that there was on record one instance in which, prior to 1898, the operator had deliberately torn out the root. This is quite true, but it should be borne in mind that the surgeon did not perform this as an operation of choice, but did it because he was unable to remove the ganglion. His patient died within a few hours, and he never repeated the operation nor recommended it to others. For the conception of the idea that division of the root was equivalent to physiologic extirpation of the ganglion credit is due to Spiller alone. Furthermore, those who have taken exception to the claim of originality ought to have known that there is a very distinct difference between avulsion of and division or resection of the root. Avulsion of the root is not only unnecessary, but what is still more important, may be distinctly harmful. Simple division of the root suffices to cause complete and persistent degeneration of the bulbospinal root of the trigeminal nerve, and the possibility of recurrence of the symptoms is therefore *nil*. Avulsion may expose even the pons to concomitant lesions (Van Gehuchten), and for this reason alone the procedure should be rejected.

## AVOIDANCE OF OCULAR DISTURBANCES.

Noteworthy in our experience is the absence of any ocular disturbances. Attention has already been called to the frequency with which the structures on its inner aspect, including the third, fourth and sixth nerves, have been injured in extirpation of the ganglion, and to their escape from injury in division of the sensory root. The most serious ocular disturbances of extirpation of the ganglion is corneal ulceration. Although no especial pains have been taken to guard against it, our cases have been entirely free from this complication. Spiller says it is probable that sympathetic fibers pass to the eye after entering the trigeminal nerve through the gasserian ganglion, and as in division of the sensory root these fibers are not injured, the danger of ocular disturbance by this operation is lessened. The trophic influence of the gasserian ganglion on the eye may possibly depend on the integrity of these sympathetic fibers, but it is probable that these fibers are not so numerous in man as in the lower animals. (The literature bearing on this subject has been carefully studied by Kreuzfuchs.) Of this phase of the subject, Van Gehuchten writes: "The persistence of the anatomic connections between the peripheral organs and the gasserian ganglion, separated from the nervous axis, without doubt, prevents the grave ocular complications mentioned by Kraus and Lauwers." The experimental investigations of Van Gehuchten himself and of Lugars and Bonne have shown that while degeneration of the fibers of the central stump follows division of the sensory root, the ganglion itself does not undergo any marked modification. This is equally true of the posterior roots of the spinal cord and their ganglia as of the cranial nerves and their ganglia.

4. *Le Névralgie*, vol. v. and University of Pennsylvania Med. Bul., April, 1904.

## METHODS OF ABBE AND VAN GEHUCHTEN.

Recognizing from his wide experience the difficulties and dangers that attend extirpation of the ganglion, Abbe recommended another operative procedure, because it was very much safer and, in his opinion, equally efficacious. This consists in division of the second and third divisions at their exits to their respective foramina and the subdural interposition of tissue. Two objections to this method of treatment at once suggest themselves: The first that the operation is applicable only to those cases in which the pain is distributed only to the second and third divisions; the second that there is a possibility of the rubber tissue acting in the rôle of a foreign body setting up a reaction in the tissues, which would terminate in abscess formation and necessitate the removal of the foreign material.

Abbe says: "It is certainly past dispute that there is no need for the removal of the first branch of the fifth pair in any case of grave tic douloureux unless the origin is to be found in a tumor of the gasserian ganglion or behind it." This may apply to the majority of cases, but it certainly is not a rule without exception. In fact, in two of the four cases which constitute this series, the pain was most intense in the distribution of the first division.

It might also be said of Abbe's operation that it offers no assurance against subsequent involvement of the first division, and so far as the mortality is concerned, it should be no less than that following division of the sensory root, since both are intracranial operations, the only difference being that in one two peripheral branches are divided, while in the other the central root of the ganglion.

Van Gehuchten, in his recent contribution to the treatment of trifacial neuralgia, recommends the tearing out of the peripheral branches, a procedure which, he says, is simpler and much more easily executed than intracranial resection. This recommendation is based on the following phenomena: Simple division of a cranial nerve nearer to or further from the base of the cranium is followed by degeneration of all the cells of origin, but with complete integrity of all or almost all of the fibers of the central end. This degeneration is only temporary, however, and is soon followed by reparation of the nerve and restoration of the function. Tearing out of the nerve, on the other hand, produces reactional phenomena much more intense; the degeneration that follows soon becomes an achromatosis, and this, in turn, is followed by atrophy and disappearance of all the injured cells. These phenomena have been observed only in motor nerves, and to prove whether sensory nerves would be affected in a similar manner, experiments were conducted on rabbits; the three peripheral branches were seized with a hemostatic forceps at their exits from the supraorbital, infraorbital and mental foramina and torn away. The results were positive; not only was there atrophy of the cells of the ganglion, but Wallerian degeneration of its bulbospinal root.

As regards the technic of the operation, the nerve should be freed as far as possible from all its connections and seized as near as possible to the base of the cranium, in order to make the resulting traumatism more intense. In reviewing the literature of the subject, Van Gehuchten found that this operation had been recommended and practiced by Blum in 1881, and later by Doyen. There seems to have been some apprehension on the part of surgeons that there was

danger in employing the force necessary to tear the nerve, of inflicting some serious injury to the brain centers. In any other cranial nerve this complication might occur, but the gasserian ganglion is so firmly attached to the base of the skull that this accident could not be considered possible.

These observations of Van Gehuchten are certainly worthy of the surgeon's consideration. If avulsion of the nerve will result in such degenerative changes of the ganglionic cells and the bulbospinal root that restoration of function is impossible, this operation should be practiced as a substitute for the intracranial operations. Whether or no surgeons at large would be willing to practice in those cases in which a so-called central operation is indicated, it should at least be given a trial, when circumstances call for a peripheral operation; that is to say, instead of resecting a portion of the inferior dental or infraorbital nerve, the nerve should be forcibly torn away. If Van Gehuchten's observations are correct, it is reasonable to assume that there would be less chance of recurrence in the case of the latter than of the former operation. Not, of course, until this operative procedure has been proven successful in its application on the human subject can it claim the support of the surgical profession. Therefore, with the exception of a few isolated cases, it is supported only by the results of experimentation on rabbits.<sup>5</sup> Davis, in 1898, operated on a case in which this idea of Van Gehuchten's was put into practice, but with unfavorable results. The superior maxillary nerve was exposed as it ran from the gasserian ganglion. The nerve, as it entered the bone, was grasped with a hemostatic forceps and pulled upward; with another forceps the nerve was grasped closer to the ganglion and twisted loose from it. The relief which followed the operation was only temporary, the pain gradually returned and became so severe as to require a more radical operation. In commenting on the case, Davis says the explanation of the return of pain is left to the experts. The operation was practiced in the manner prescribed by Van Gehuchten; it might be claimed that the twisting out of the nerve was not sufficiently violent or brusque, but this view is hardly acceptable.

REMARKS BY DR. SPILLER.<sup>6</sup>

In studies of the nervous system of dogs,<sup>7</sup> in which the sensory root had been cut, I found that when only the external part of this root was divided the degeneration in the spinal root of the trigeminal nerve of the pons and medulla oblongata by the Marchi method was only in the dorsal part of the root. This is well shown by photographs in the article referred to. I believed from these investigations, published in December, 1901, that I was justified in concluding that the fibers of the lateral portion of the sensory root at its entrance into the pons, in their further course, occupy the dorsal part of the descending spinal root. From this it follows that the fibers of the inner portion of the sensory root occupy the ventral portion of the descending spinal root.

The investigations of Van Gehuchten on the changes occurring in the sensory root of the trigeminal nerve, after tearing out peripheral branches of this nerve, are important. He says, in relation to this subject: "This

5. University of Pennsylvania Med. Bull., April, 1904.

6. The following observations on the relative position of the fibers belonging to the three peripheral branches of the trigeminal nerve in the gasserian ganglion and the sensory root and their continuation in the spinal root are by Dr. Spiller, including an explanation for the limited area of anesthesia of the face occurring after partial division of the sensory root.

7. Spiller and Frazier: University of Pennsylvania Med. Bul., December, 1901.

degeneration of the fibers of the bulbospinal root, after a tearing out of the peripheral nerves, is so constant that we have encouraged one of our students, Dr. Bochenek, to employ this method in determining the situations in the bulbospinal root of the fibers belonging to each of the three branches. The results of his investigations have shown that after a tearing out of the frontal nerve the degeneration is localized exclusively to the ventral portion of the bulbospinal root; after a tearing out of the mental nerve, it occupies the dorsal portion of the same root. The tearing out of the infraorbital nerve is followed by a degeneration of a certain number of fibers in the middle region.

"Our own recent investigations are in support of these findings. They show, further, that the number of fibers in degeneration of the bulbospinal root is in direct relation to the number of peripheral fibers that have been ruptured. Bochenek, in his investigations, was content to tear out only one of the branches of the ophthalmic nerve of Willis, the frontal nerve; he obtained distinct

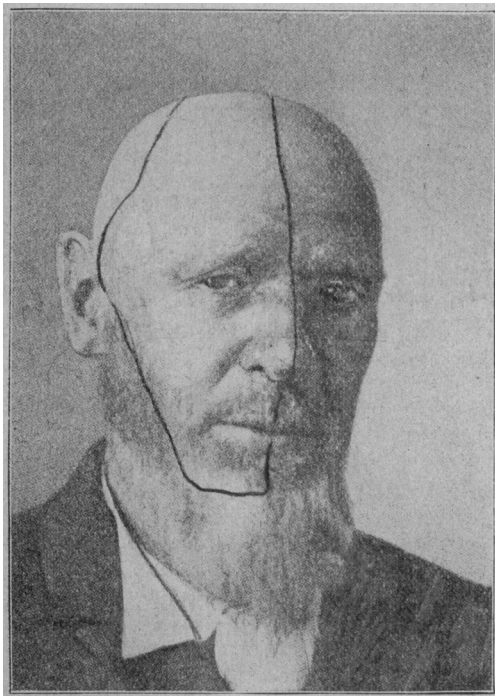


Fig. 1.—Showing the area of anesthesia one week and thirty-two months after division of the sensory root.

degeneration involving a small number of nerve fibers at the ventral extremity of the bulbospinal root. In our own investigations we have torn out the three branches of the ophthalmic nerve, emptying completely the orbital cavity. After a survival of forty-five days we have obtained a much more extensive degeneration of the ventral portion of the bulbospinal root.

"This degeneration of the fibers of the bulbospinal root can be understood, in our opinion, only by admitting that rapid atrophy occurs in a certain number of cells in the semilunar ganglion, an atrophy following the tearing out of the peripheral branch. We desired to determine the existence of this atrophy by the examination of the gasserian ganglion, but our investigations have not been successful. After the tearing out of one or the other of the three branches of the trigeminal nerve, chromolysis of the cells in the ganglion is found after about ten days, but if the animal is allowed to live fifty or sixty or eighty days it is impossible to determine whether the

number of nerve cells has diminished in the ganglion on the operated side, even after a tearing out of all three nerves, frontal, infraorbital and mental. These results should cause no surprise; the gasserian ganglion is difficult to remove; it has, further, a very complex structure; its constituent cells, instead of being placed one close against the other, are usually situated in long bands, like islands, between the fasciculi of nerve fibers, which they accompany in a certain part of the nerve. It is, furthermore, very difficult, if not impossible, to make comparable serial sections of the two semilunar ganglia of the same animal.

"Having in mind the Wallerian degeneration of the fibers of the bulbospinal root after a tearing out of the branches of the trigeminal nerve, and the cellular phenomena which occur in the cells of origin of the peripheral nerves after the tearing out, we believe that we may conclude that the tearing out of one or the other branches of the trigeminal nerve is followed by rapid atrophy of the corresponding cells of the gasserian ganglion, an atrophy which causes in its turn Wallerian degeneration of the central fibers. It is, therefore, proper to propose the tearing out of the nerve as a rational surgical treatment of trifacial neuralgia."<sup>8</sup>

Comparing Van Gehuchten's results with those obtained by me, it will be seen that the fibers of the ophthalmic nerve are represented in the ventral portion of the descending spinal root of the trigeminal nerve (Bochenek, Van Gehuchten), and that the fibers of the inner portion of the extrapontile sensory root are represented in the ventral portion of the descending sensory root (Spiller); therefore, these fibers do not mix with those belonging to the other peripheral branches of the trigeminal nerve; likewise that the fibers of the third division are represented in the dorsal part of the descending spinal root (Bochenek, Van Gehuchten), and that the fibers of the external portion of the extrapontile sensory root are represented in the dorsal portion of the descending spinal root (Spiller), and, therefore, these fibers do not mix with those belonging to the other peripheral divisions of the trigeminal nerve.

This is an important conclusion, because if only the outer portion of the sensory root of the trigeminal nerve is cut loss of sensation should be expected only in the third division of the nerve, and we may conclude when loss of sensation is found also in the distribution of the second division that at least half the sensory root is cut through. This explains why sensation of the face is only partially lost when only a portion of the sensory root is cut, and in such cases it will probably be found that the anesthesia is in the third division of the trigeminal nerve, because the external fibers of the sensory root are more likely to be divided than the inner.

Recent anatomic studies in the territory innervated by the sensory root of the trigeminal nerve, show that this territory is less extensive than formerly supposed. The sensory area of the trigeminal nerve as shown by Otto Grosser does not extend to the chin.<sup>8</sup> In the diagram of Frohse, the cervical nerves supply the sensation to a considerable area of the face above the chin. According to Zander, the area of the cervical nerves extends almost to the corner of the mouth, and is only about a finger-breadth from the bony orbital border. It is very important that these facts should be borne in mind when the extent of the anesthetic area caused by resection of the sensory root is tested.

8. Grosser: *Centralblatt für die Grenzgebiete der Medizin u. Chirurgie*. Feb. 23, 1904.

## SYMPATHETIC FIBERS IN THE GANGLION OF GASSER.

The effect on the sympathetic fibers of the eye from operations on the trigeminus is worthy of attention. Kreuzfuchs has collected considerable proof of the existence of sympathetic fibers in this nerve.

Budge cut the trigeminus in animals, in some cases through the trunk, in others peripherally to the ganglion, and found that after either operation contraction of the pupil occurred. After central division of the fifth nerve the pupil did not contract so greatly nor persistently as after peripheral division of the nerve. Budge assumed that the trigeminus receives in the gasserian ganglion those sympathetic fibers which innervate the dilator pupillæ, and this opinion has been held by all subsequent investigators who have studied the motor tract for the dilatation of the pupil. These fibers pass from the gasserian ganglion to the eye through the first division of the trigeminus, and therefore contraction of the pupil occurs after division of the trigeminus.

Schiff also found that dividing the trigeminus causes contraction of the pupil, and that there is a difference when the division is made behind or in front of the gasserian ganglion.

Claud Bernard found that the pupil contracts after division of the trigeminus and after a certain time dilates but never attains the same size as the pupil on the other side. These phenomena occur after central as well as after peripheral division of the fifth nerve, but these changes are much more striking and are associated with disease of the cornea when the division is peripheral.

Balogh concluded that all pupillary dilator fibers pass through the gasserian ganglion and the first division of the trigeminus.

Similar opinions were held by Oehl and Gutmann, although the latter believed that no pupillary dilator fibers arise in the medulla oblongata, as Balogh had assumed, and that the division of the trigeminus stem has no effect on the pupil. This view has been shown to be incorrect by Claud Bernard and by Kreuzfuchs.

Budge having believed that the trigeminus contains motor dilator fibers, later investigators have tried to determine whether these fibers are a part of this nerve or merely received from the sympathetic. From the investigations of Schpilow and Braunstein, it seems to be decided, at least for many animals, that the trigeminus receives the dilator fibers of the pupil through the gasserian ganglion.

Kreuzfuchs has cut the trigeminus in rabbits on the base of the brain. The pupil was smaller immediately after the operation than it was later. In these animals exposure and irritation of the cervical sympathetic on the operated side caused maximal dilatation of the pupil on the same side, so that the dilator fibers could not have been cut.

Examination of cases in which the gasserian ganglion has been removed in man seems to show that removal of this ganglion does not cause contraction of the pupil, so that Kreuzfuchs doubts whether what is true of the lower animals is true also of man, viz., that all dilator fibers of the pupils pass through the gasserian ganglion, and he is inclined to accept the view that in man the dilator fibers act through the abducens. He says, however, that after removal of the gasserian ganglion in man, the pupils are of equal size in the

light, but in shadow the pupil on the unoperated side is larger.<sup>9</sup>

It seems probable from these observations that even in man a certain number of sympathetic fibers enter the gasserian ganglion, but in a case of division of the sensory root reported in 1901 by Dr. Frazier and myself no difference in the size of the pupils in shadow can now (May 21, 1904) be determined. After several years a readjustment of the pupillary mechanism is to be expected.

## RESUME OF FOUR CASES.

CASE 1.—J. L., age 68. Duration of affection, five years. Previous treatment, four peripheral operations. The first division alone was involved.

Operation.—October 12, 1901. Two years and eight months ago.

Result.—No recurrence.

CASE 2.—S. R., age 79. Duration of affection, three years. Preliminary treatment, course of hypodermic injections of strychnia with only temporary relief. Third and second divisions involved in the order named.

Operation.—October 21, 1902. One year seven and one-half months ago.

Result.—No recurrence.

CASE 3.—A. W., age 54. Duration of affection, nine years. Treatment, nil. Second and third divisions involved in the order named.

Operation.—March 31, 1903. One year and two months ago.

Result.—No recurrence.

CASE 4.—F. S., aged 54. Duration of affection, 14 months. Previous treatment, nil. First and second divisions involved.

Operation.—March 17, 1904.

Result.—No recurrence.

## OSMIC ACID INJECTIONS FOR RELIEF OF TRIFACIAL NEURALGIA.\*

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CHICAGO.

The publication of Delbastaillé's<sup>1</sup> article on the injection of osmic acid in inoperable tumors and its subsequent use in the same direction by von Winiwarter<sup>2</sup> and others, attracted much attention, but the results were unfavorable and its use was abandoned. During this experimentation Neuber reasoned that, as osmic acid has a special affinity for the medulla of peripheral nerves as a stain, it might prove beneficial in a clinical way. At this juncture a patient presented himself who had been suffering from neuralgia of the first and second branches for six years on whom, Aug. 15, 1880, a resection of the second division by Professor Albert, on the plan of Lücke, von Bruns and Lassen, had been made. The patient experienced relief for one year, then had several relapses. On Nov. 30, 1882, there was a ligation of the carotid, with no relief. From Jan. 18 to Feb. 9, 1883, daily injections of 4 to 6 drops of a 1 per cent. solution of osmic acid in water were given, inserting the fluid near the infraorbital foramen, angle of the nose and in the lower lip. The relief was only short lived and by the middle of June the pain returned. A second similarly treated case was well at the end of three months. A third case of sciatica had the injections over the sciatic nerve at the site of pain. The patient remained well up to the time of publication of this article.

9. Kreuzfuchs: Obersteiner's Arbeiten, vol. x, p. 275.

\* Read at the Fifty-fifth Annual Session of the American Medical Association, in the Section on Surgery and Anatomy, and approved for publication by the Executive Committee: Drs. DeForest Willard, Charles A. Powers and J. E. Moore.

1. Centralblatt für Chirurgie, 1882, No. 48.

2. Mittheilungen aus der Chirurgische Klinik zu Tübingen, 1883, p. 213.