DIFFERENTIAL SECTION OF THE TRIGEMINAL ROOT IN THE SURGICAL TREATMENT OF TRIGEMINAL NEURALGIA[1]

By Byron Stookey, M.D.

of New York, N. Y.

In the development of the surgical treatment of any disease the principle of evolution with its additions, subtractions, trial and error is not infrequently seen, usually with a constant trend toward greater specialization in the procedures used. Archaic methods, however, remnants of a former age, are frequently adhered to by the profession at large, long after they have been proved obsolete by those working more intensively in the particular field. Section of the nerves within the skull distal to the gasserian ganglion, operations on the peripheral branches, alcoholization of the gasserian ganglion, and of the branches, and total section of the trigeminal roots, both motor and sensory, are among such archaic methods, though there are exceptional instances when some of these procedures may still be indicated.

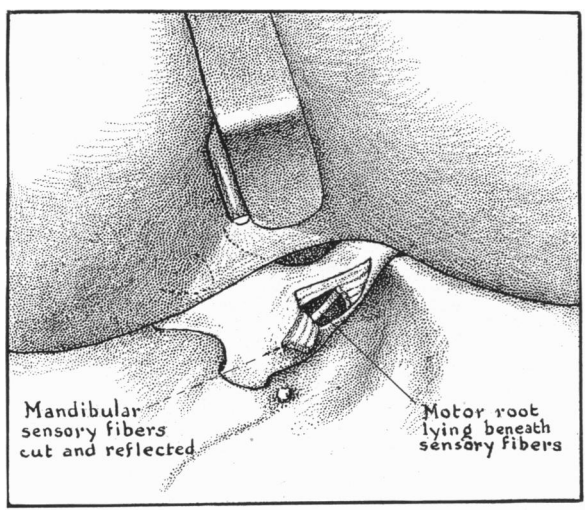

Fig. 1.—Differential section of the trigeminal neuralgia limited to the mandibular division. The sensory fibres of the dorsal root derived from the mandibular division are cut without cutting the maxillary or ophthalmic fibres. The motor root lying beneath the sensory root is identified and saved.

In the evolution of the surgical treatment of trigeminal neuralgia there have been a number of refinements of procedure, the most important of which was the substitution of complete section of the dorsal root for the older procedure of removal of the gasserian ganglion—an advance suggested by Spiller and first carried out by Frazier. The method suggested by Spiller was generally adopted in this country until further refinements in the procedure were developed by Dr. Charles Frazier, who saved first the motor division, while cutting all of the sensory root, and later saved not only the motor division but the ophthalmic fibres of the sensory root as well. A still further refinement in the surgical treatment of trigeminal neuralgia was

[1] Read before the New York Surgical Society, December 14, 1927.

presented sometime ago by the writer [2] before the New York State Medical Society, Section on Surgery and Neurology, namely, *differential section* of the dorsal root, those fibres within the dorsal root derived from the mandibular division being selected for section when the pain occurs in the domain of the mandibular nerve, and those from the maxillary division for pain in the domain of the maxillary, the remaining fibres being left intact.

Frequently tic douloureux remains limited to the mandibular division for many years before spreading to the maxillary or the ophthalmic division. In differential section fibres derived from the mandibular nerve within the dorsal root are differentiated and cut, leaving the patient with a relatively limited area of anæsthesia and yet free of pain. In cases with pain limited to one division, differential section of the fibres from that division the writer feels is of distinct advantage, a more conservative procedure, and a further desirable refinement of technic, since the destruction of sensory fibres is reduced to a minimum, with complete relief of pain.

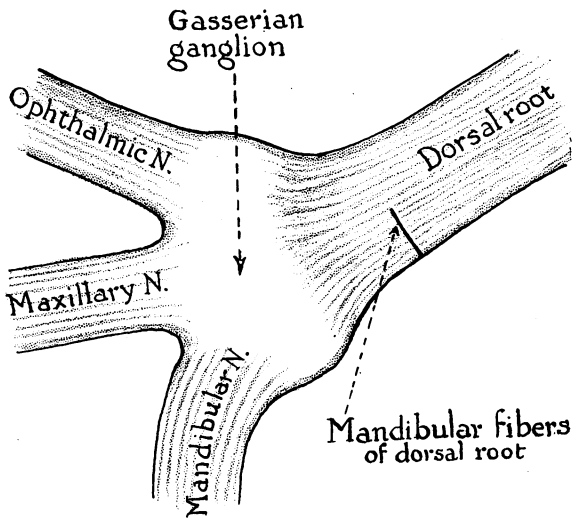

FIG. 2.—Schematic drawing of the gasserian ganglion and dorsal trigeminal root. Line of section to cut the sensory fibres derived from the mandibular division.

In view of these refinements of technic, it does not seem justifiable to treat trigeminal neuralgia in an expectant manner, since, so far as we know no means of permanent relief has been found other than section of the fibres carrying the pain impulses. Once the diagnosis is definitely established, surgical intervention is indicated.

Alcoholization of the nerve trunks, commonly employed in the treatment of trigeminal neuralgia, is an archaic procedure developed at the time when removal of the gasserian ganglion was the only operative means of relief offered. This operation, even in the most skilled hands, had a mortality rate of approximately 14 per cent., and trophic disturbances of the eye were a common sequela. Naturally, under such circumstances any procedure giving relief was preferred to operation. Since then, however, a complete revolution in the operative procedure of trigeminal neuralgia has taken place. The mortality rate has been reduced to less than 1 per cent., local anæsthesia is used as suggested by Alfred S. Taylor, and refinement of technic has made it pos-

[2] Differential Section of the Trigeminal Root in the Surgical Treatment of Trigeminal Neuralgia, New York State Society, New York City, March, 1926.

sible to secure permanent and complete relief of pain with the production of a minimum anæsthetic area. Alcohol injection, on the other hand, is an extremely painful procedure and gives only temporary relief. Operation must eventually be done, frequently after the patient is considerably older and the operative risk greater. The invariable query of patients who, after a series of alcohol injections, have come at length to differential section, is: "Why did I not have an operation in the first place and spare myself the torture of repeated alcohol injections?"

The injection of alcohol into the nerve trunk is furthermore not without danger, since occasionally the arachnoid sheath covering the nerve may descend an unusual length along the nerve trunk and alcohol consequently be injected into the subarachnoid space. For similar reasons injection of alcohol into the gasserian ganglion is dangerous. Since the gasserian ganglion is surrounded by the arachnoid membrane alcohol may be injected into the subarachnoid space and along the dorsal root into the basal cysterne. Alcoholization of the ganglion should, therefore, be condemned. An unfortunate case in which alcohol injection into the gasserian ganglion was followed by nearly complete paralysis of all of the cranial nerves on both sides has been reported. While it is true that such untoward complications are rare, they are pointed out as evidence that alcohol injection in itself is not altogether as harmless as is generally believed. Alcohol injections should not be used as a routine procedure in the treatment of trigeminal neuralgia, but should be reserved for those special cases in which there is doubt as to the diagnosis, or in which operation of any kind is contra-indicated because of the patient's general condition, or because of some disturbance in vision on the affected side, etc.

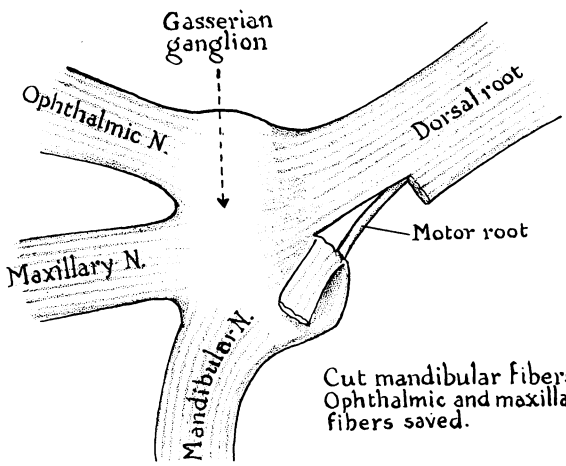

FIG. 3.—Same as 2 with mandibular division cut and reflected showing the motor root passing diagonally beneath the sensory root. The motor root is saved.

Neuralgia in the ophthalmic division is extremely uncommon, occurring in less than 5 per cent. of those afflicted with trigeminal neuralgia. Where there is pain referred over the ophthalmic division, this is frequently found to have originated in the maxillary division, radiating secondarily in the ophthalmic area. To classify such cases as neuralgia of the maxillary *and* ophthalmic divisions is inaccurate and misleading. They are properly called primary maxillary neuralgia with secondary ophthalmic neuralgia, and are

to be distinguished from the rare cases of primary pain in the ophthalmic distribution. If this distinction is made, cases of ophthalmic neuralgia are found to be even rarer than the figures given above would indicate.

That pain in the ophthalmic division is frequently an overflow phenomena rather than true primary pain is suggested by the fact that injection of alcohol into the second division may relieve not only the pain in the second division, but also that referred along the ophthalmic division; similarly injection of the mandibular division may relieve secondary or referred pain in the maxillary division. While relief of secondary pain may not be experienced if the pain is of long duration, in cases seen early, before the secondary pain impulses have become permanently fixed, complete relief is usually obtained by treating the division primarily involved.

These observations have had an important bearing in pointing the way toward differential section of the dorsal root. In several patients in whom pain occurred primarily in the maxillary division, radiating later into the ophthalmic and mandibular divisions, the ophthalmic has been deliberately spared when section of the dorsal root was done, with relief of all pain. Thus even in some cases of so-called ophthalmic neuralgia, section of the maxillo-mandibular division has given complete relief. The ophthalmic division should be cut only when it is the primary source of the pain. It is thus extremely important to distinguish between the primary and secondary ophthalmic neuralgias, that the ophthalmic division may be saved in all cases except those showing primary involvement of this part of the trigeminal nerve. This is a new conception and is as yet in the experimental stage. It may well be that those in whom this distinction has been made may have recurrence of pain in years to come. Time and further experience alone will tell. One patient, indeed, has had recurrence of pain though in this instance there was some doubt as to whether the ophthalmic pain was primary or secondary. It is my practice to explain the situation to the patient and to the physician by whom he is referred, so that the possibility of recurring pain may be fully appreciated.

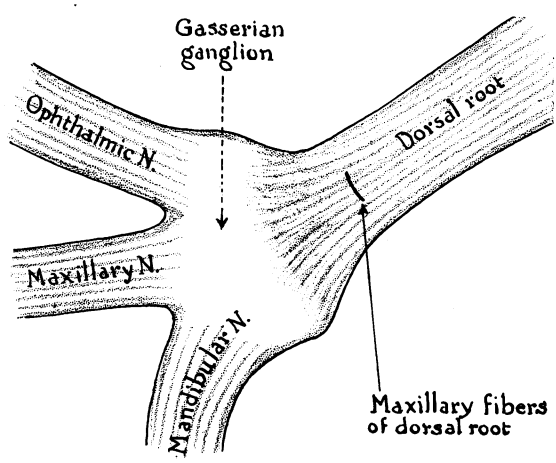

FIG. 4.—Line of section to cut the sensory fibres derived from the maxillary division.

Usually a second operation in an old operative field presents special difficulties, but such is not the case with differential section of the trigeminal root. The line of cleavage between the dura and the bone is as readily followed at the second operation as at the first, and bleeding is less, since the

foramen spinosum is already plugged and a dry field is usually assured. Identification of the gasserian ganglion and the dorsal root offers no special difficulty. Since a second operation is as easy or easier than the first, a conservative attitude can be more readily adopted; an obvious advantage.

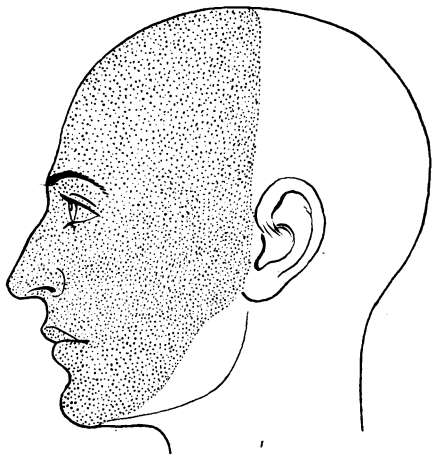

FIG. 5.—Area of anæsthesia after total section of the trigeminal root.

Abundant comparative anatomical and embryological evidence is at hand to indicate the separateness of the ophthalmic nerve from the maxillo-mandibular nerve. The trigeminal nerve is in reality two nerves—the ophthalmic and maxillo-mandibular, which become fused into one. In the lower animals the ophthalmic develops as a separate nerve having its own ganglion and distinct peripheral and central connections. It develops in front of the second myotome while the maxillo-mandibular rises caudal to the second myotome. Later the ganglion of the ophthalmic nerve fuses with the maxillo-mandibular ganglion and the central connections to the brain stem join those of the maxillo-mandibular to enter the brain stem as a common dorsal root. Further evidence of the separateness of these two nerves is seen within the brain-stem, where the central arms of the ophthalmic and maxillo-mandibular nerves are found as two separate bundles in the descending trigeminal tract, the ophthalmic lying more ventral and the maxillo-mandibular more dorsal.

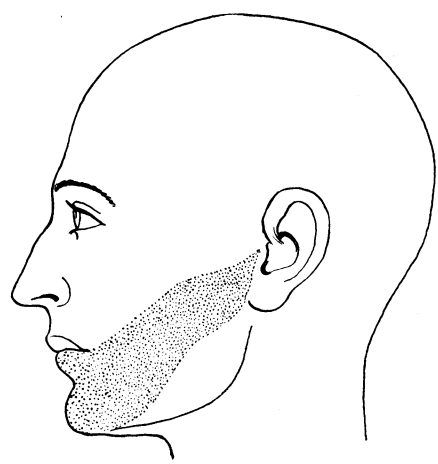

FIG. 6.—Area of anæsthesia after differential section of the trigeminal root for pain limited to the mandibular division (see figure 1).

Human embryological evidence, as pointed out by Giglio Tos (1902)[3] and Frazier and Whitehead (1926)[4] show that the adult gasserian ganglion develops as two separate ganglia, one for the ophthalmic and another for the maxillo-mandibular divisions.

Thus both comparative anatomy and embryology furnish an undeniable basis for the view that the trigeminal nerve is really made up of two nerves, one the ophthalmic and the other the maxillo-mandibular, having had at one

[3] Tos, Giglio: Sull' origine embrionale del nervo trigemino nell' uomo. Anat. Anzeiger, vol. xxi, 1902.

[4] Brain: Vol. xlviii, p. 458, 1926.

time in their phylogeny separate ganglia, separate dorsal roots, separate entrances, and a separate course within the brain-stem. With such a foundation, one feels more secure in treating trigeminal neuralgia, not as a unit involving the whole of the adult trigeminal nerve, but as affecting two entities brought together only in their grosser morphology yet retaining their individuality in their clinical manifestations. As often happens, phylogenetic studies point the way to clinical understanding and to more rational and specialized surgery.

In view of such studies and of the clinical observations referred to earlier in this paper, the conservative treatment outlined is felt to be justifiable. As has been mentioned, the profession is greatly indebted to Dr. Charles Frazier for suggesting first that the motor root be saved, and second, that the ophthalmic division be saved in those cases in which the pain is limited to the maxillo-mandibular divisions. This operation Doctor Frazier has designated as "subtotal resection".

FIG. 7.—Photograph of patient showing area of anæsthesia after differential section of the dorsal trigeminal root. The fibres within the dorsal root derived from the mandibular division were cut for major trigeminal neuralgia with the pain limited to the mandibular division. The sensory fibres from the ophthalmic and maxillary division have been saved as well as the motor root.

A further step in advance, the writer believes, is marked by the suggestion presented some time ago, before the New York State Medical Society, namely that in those patients having so-called ophthalmic neuralgia a distinction be made between primary and secondary ophthalmic pain and that the ophthalmic fibres of the dorsal root be cut only in those in whom the pain in that division is primary. As a still further refinement in the surgical treatment of trigeminal neuralgia, it was suggested that the dorsal root fibres central to the ganglion derived from the mandibular be cut when the mandibular division is the source of pain, or the maxillary when the maxillary is the source of the pain. This procedure which the writer has termed "differential section" has been found valuable by the additional experience since gained. Thus by differential section only those fibres central to the ganglion are destroyed which carry the pain impulses. As yet a sharp line of separation between the maxillary and the mandibular divisions within the dorsal root has not always been possible. An overlap of one or two funiculi is likely to occur at the line of section. With further experience, however, it seems probable that more accurate separation of these funiculi will be possible, and that *differential section of the dorsal root* will find increasing application.

CONCLUSIONS

(1) A distinction should be made between primary and secondary or referred neuralgia of the ophthalmic, the maxillary or the mandibular divisions. In early cases of primary neuralgia of the ophthalmic, maxillary or mandibular divisions section of the fibres in the dorsal trigeminal root derived from the division along which the pain impulses are carried, should be done without section of the remaining fibres. In long-standing cases distinction between primary and secondary neuralgia of the various divisions cannot always be made and section of the fibres from two divisions may be necessary, hence early diagnosis and surgical treatment is advisable as soon as the diagnosis is definitely established.

(2) *Differential section* is a further refinement in the surgical treatment of trigeminal neuralgia which has proven a satisfactory procedure in the cases done since the writer's first report was made before the New York State Medical Society in 1926.

(3) By *differential section* is meant section of the fibres within the dorsal root central to the ganglion derived from the division producing the pain without section of the remaining fibres. If the pain is in the mandibular division, the mandibular fibres central to the ganglion are cut without cutting the maxillary or ophthalmic fibres. If the pain is in the maxillary these fibres are cut without injury to the mandibular or ophthalmic fibres. If the pain is in the ophthalmic alone without involvement of the maxillary or mandibular, the ophthalmic fibres are cut.

(4) By *differential section* the fibres are differentiated along which the pain impulses are carried and these only are cut. Thus both the anæsthetic area and the attendant paræsthesias are reduced to a minimum.