Mears (J. E.)

STUDY

OF THE

PATHOLOGICAL CHANGES OCCURRING

IN

TRIFACIAL NEURALGIA.

WITH THE

REPORT OF A CASE IN WHICH THREE INCHES OF THE INFERIOR DENTAL NERVE WERE EXCISED.

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PROFESSOR OF ANATOMY AND SURGERY IN THE PENNSYLVANIA COLLEGE OF DENTAL SURGERY; SURGEON TO ST. MARY'S HOSPITAL, PHILADELPHIA, ETC.

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With the Report of a Case in which Three Inches of the Inferior Dental Nerve were Excised.

An examination, somewhat extended, of the literature relating to neuralgia of the fifth nerve has shown that in those cases in which resort has been had to the employment of surgical procedures as methods of treatment, no investigations, or, if any, very incomplete investigations have been made to determine the character of the pathological changes which have been present and upon which the morbid conditions have been founded. Thus, of twenty-four cases reported by Mr. Thomas F. Chavasse to the Royal Medical and Surgical Society of London, in which surgical operations had been performed, but two reports, and these very incomplete, were made of the condition of the nerve involved. The absence of these investigations has interfered, it seems to me, materially with any radical progress in the application of remedial measures, and has resulted largely in the use of those which are empirical in character. Believing that we can arrive at rational methods of treatment only by increasing our knowledge of the pathological conditions which exist in cases of chronic prosopalgia, I have ventured to submit the report of a case in which free neurectomy was performed, and in which a careful study was made of the diseased structure removed.

The patient, a German woman, aged fifty years, consulted me eight years and a half preceding the operation, which was performed

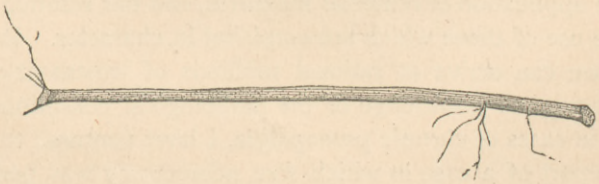
on the 27th of August, 1883, for intense neuralgic pain involving the left inferior dental nerve. The pain originated in the second bicuspid tooth, which was in a state of caries, and passing backward gradually implicated the remaining teeth, which were sound. The carious tooth was removed without affording relief, and subsequently the remaining teeth with the same result. The treatment instituted at this time afforded but slight relief, and the patient passed from under my care. After an interval of four years she again consulted me, having in the mean time received treatment from a number of physicians, with but transient relief. I found on examination that the area of pain had increased, and that the periods of cessation were diminishing. The prolonged use of various anti-neuralgic remedies, combined with the application of the constant current of electricity, availed but little, and I suggested neurectomy, which she declined, and again sought other advice.

Four years and a half later she returned and stated that she was prepared to submit to any operation I deemed necessary to perform, as her life was a burden. She had fallen into the hands of empirics, and had, as she expressed it, passed through "fire and water" without relief of the pain, which was now constant and excruciating.

The disease had now assumed the epileptiform variety; the paroxysms occurred at intervals of a quarter and a half of a minute, excited by a breath of air, the touch of the fingers, or the placing of food or water within the mouth in contact with the side affected.

On the 27th of August, 1883, I performed neurectomy, removing three inches of the inferior dental nerve, including all of it which

Fig. 1.



The portion of the nerve removed.

was contained within the canal, and a portion extending beyond the mental foramen shown in Fig. 1. The external surface of the

bone was exposed by an incision carried from the middle of the posterior border of the ramus along the base to a point beyond the position of the mental foramen and reflecting the flap.

A one-half inch trephine was applied over the position of the inferior dental foramen, and a disk of bone, including the outer table, was removed. The mental nerve was dissected to the distance of half an inch beyond its point of exit from the foramen and divided. A dental burr attached to the surgical engine was now used to enlarge the mental foramen and release the nerve. Traction was made upon the nerve at the point where it was exposed by the trephine, and it was withdrawn entire from the canal. Before dividing it posteriorly it was drawn down so that the division might be made as high up as possible, and the stump was pushed back until it was entirely beyond the foramen. The artery, which was torn in the manipulations employed to remove the nerve, was divided and the end twisted; no hemorrhage followed. An examination of the nerve in its position in the canal showed that it was swollen and reddened, and the artery appeared to be so compressed and flattened that it occupied very much less of its relative space in the canal. The facial artery was caught by an acupressure needle and held until the completion of the operation, when a ligature was applied. The wound healed in six days. The patient was free from pain, and, with the exception of one or two spasms of pain occurring apparently in the stump of the nerve, she has remained so until this date, nearly nine months after the operation.

The opportunity being presented of studying the conditions which follow the removal of so large a section of the nerve, I made, ten weeks after the operation, two careful examinations of the parts supplied by it, the last examination being made in conjunction with Dr. J. T. Eskridge, of Philadelphia. On the day of this examination, November 9, 1883, the weather was damp, and the surrounding atmosphere 65° F. Over the external surface of the lower lip, comprising the area of terminal distribution of the mental branch of the left inferior dental nerve, a sharply defined zone of complete anæsthesia and analgesia was found. This anæsthetic area was irregular in shape, and measured transversely at margin of lip $1\frac{3}{16}$ inch; at the lower border of the zone (a slightly curved line) $\frac{5}{16}$ of an inch;

vertically $1\frac{1}{2}$ inch; transversely at the middle $1\frac{1}{16}$ inch; border over symphysis (slightly convex line) $1\frac{5}{16}$ inch; at external margin towards ramus (slightly concave line) $1\frac{5}{16}$ inch; over this zone the patient was unable to recognize contact of cold or hot substances. Over a small portion of the lip, and outer surface of the alveolar border, corresponding to the anæsthetic area just described, anæsthesia and analgesia were complete. The inner surface of the alveolar border was everywhere sensitive. Over a limited area, extending forward from the position of the inferior dental foramen to the posterior border of the zone of complete anæsthesia, the ability to recognize tactile sensations, painful impressions, and the contact of heat and cold was diminished. Considerable swelling was noticeable on the left side of the face, with slight drooping of the eyelids, and partial obliteration of the vertical fold extending downward from the angle of the mouth. The surface of the skin was roughened, and presented the appearance of a somewhat diffuse capillary congestion. Formication was present, and was especially marked on passing from the cold air outside to the warm rooms of the house.

The following surface temperature observations were made, beginning at 11.29 A. M., and continuing until 12.32 P. M.:—

Axillary temperature: right, 98°; left, 98°.

Over infraorbital foramen: right, 98.1°; left, 98.1°.

Over inferior dental foramen: right, 97.7°; left, 97.9°—$\frac{2}{10}$° difference.

Near upper border of lower lip: right, 97.4°; left, 97.7°—$\frac{3}{10}$° difference.

Incisive fossa about the middle of anæsthetic zone; right, 96.4°; left, 97.2°—$\frac{8}{10}$° difference.

From the above examination, information was gained as to the area of surface supplied by the terminal branches of the inferior dental nerve, and which, in diseased conditions of the nerve, become the seat of the painful impressions. The existence of slight paralysis of the orbicular and cheek muscles would seem to indicate that by reason of the free anastomoses (correctly speaking, unions, or connections) between the termi-

nal branches of the fifth and facial nerves, the excision of a branch of the former had apparently affected the function of the terminal branches of the latter. The incision made did not divide any of the larger branches of the facial nerve, and certainly none of those distributed to the orbicular muscle of the eye. In the same manner as the above, may we not explain the painful spasm which occurs in prosopalgia of the epileptiform variety, the facial muscles acting under the motor impulses created by the transmission of the morbid impressions from the diseased sensitive, to the normal motor nerve?

The slight elevation in temperature noted at different points in the anæsthetic zone is in accord with the physiological results obtained after nerve-sections, although Dr. S. Weir Mitchell observes, in his work on *Injuries of Nerves* (edition of 1872), that he is not aware of any clinical observation which records the early rise in temperature after total section of the main nerve of a member. The elevation in temperature is explained as the result of dilatation of the bloodvessels caused by the vaso-motor paralysis.

The portion of nerve exsected was given for careful examination to Dr. G. de Schweinitz, of Philadelphia, who submitted the following report:—

"Macroscopically, the portion of nerve presented for examination did not exhibit any changes except, perhaps, a slight thickening beyond what is usual in the normal inferior dental nerve. The thickest portion of the excised nerve corresponded in size to a No. 7 bougie (French scale), and the thinnest to that of a No. 6. The nerve was hardened for section by placing it in Müller fluid, and then in ordinary alcohol for two days. Transverse and horizontal sections were made and stained with Klein's carmine and hematoxylin solutions, dehydrated in alcohol, cleared up in oil of cloves, and permanently mounted in dammar. For the purposes of comparison, similar sections of a normal external branch of the radial nerve were made after it had been subjected to a precisely similar hardening process.

"In Fig. 2, within the perineurium, are seen the cross-cuts of the nerve-fibres, separated from one another by the delicate tissue known as endoneurium, which is here and there crossed by fine

trabeculæ of connective tissue subdividing the fasciculus. Each nerve-fibre is composed of a dark, central spot, representing the axis-cylinder surrounded by a white circle—the medullary sheath. The whole is inclosed within a double-contoured external ring, the

Fig. 2.

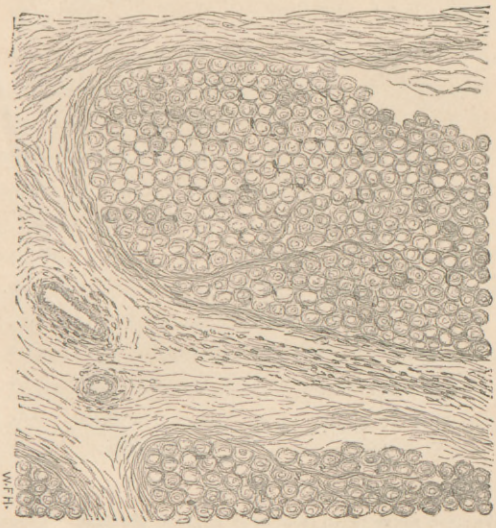
Cross-section of the normal external branch of the radial nerve. Cross-sections of the individual nerve-fibres are seen, showing axis-cylinder, medullary sheath, and neurilemma. The fasciculi are subdivided by trabeculæ of connective tissue. Bloodvessels are seen in cross-section.

sheath of Schwann or neurilemma. The supplying bloodvessels are seen in cross-section in the connective-tissue investments of the nerve.

"Figs. 3 and 4 represent the microscopic characters of the diseased nerve. Some slight increase and thickening of the connective-tissue sheaths investing the fasciculi as well as of the trabeculæ dividing them is noted, together with a change in their regular arrangement. The walls of the bloodvessels, both in cross-section and in Fig. 3 when viewed in vertical section, are surrounded by a lymphoid infiltrate. Here and there, scattered through the connective tissue, are small collections of minute, yellowish-white, glis-

tening dots, representing probably foci of fatty degeneration. The chief changes are in the nerve-tubes themselves. The axis-cylinders cannot be satisfactorily demonstrated. When present they are not stained with carmine, and are often apparently entirely wanting.

Fig. 3.



Section of the diseased nerve taken from near the mental foramen. The irregular and confused outlines of the nerve-tube are shown, together with the concentric arrangement of the arches. The connective tissue is moderately thickened. Three bloodvessels are seen, two in cross-section, and one longitudinally, surrounded by small-celled lymphoid infiltrate showing thickened walls.

The medullary sheath appears swollen, and the cross-cuts of the individual nerve-fibres are not clearly defined and sharply cut, but consist of a confused mass of concentric rings. The sheath of Schwann often has a crumpled appearance. The transverse sections of nerve-fibres might in many places be not incorrectly compared to the interior aspect of a minute oyster-shell both in shape and by virtue of this peculiar concentric arrangement. Longitudinal sections reveal increase of the nuclei of the sheath of Schwann. The changes thus described show a parenchymatous neuritis, as is indicated by the degeneration in the nerve-fibres as well as changes in the connective tissue of an inflammatory type, as is shown by its

thickening and the alterations in and about the bloodvessels. The neuritis is probably also of an ascending nature, as the changes in

Fig. 4.

Section of the diseased nerve taken from near angle of the jaw. Changes the same as those above, only less marked. Here and there nerve-tubes of normal appearance are noted. The same concentric arrangement, and also alteration in bloodvessels, are seen.

the diseased nerve are more marked about the mental foramen and grow less noticeable as the angle of the jaw is approached."

It has been observed that the anatomical distribution or rather arrangement of the large nerve-trunks of the body, is such that they are protected by position from injury. Thus, those of the upper and lower extremities are placed, where they enter the parts and are superficial, on the inner aspects; in the forearm and leg they are covered by muscular masses, and in passing to their terminal distributions they are surrounded by facial envelopes which more or less protect them. Notwithstanding the protection afforded, there are certain nerves in which chronic forms of neuralgia appear which are very often traumatic in origin. Thus, the sciatic nerve may be readily injured at the

point of emergence from the pelvic cavity—the sacro-ischiatic notch—by falls and kicks, giving rise to inflammatory conditions and resulting degenerative changes, and in this manner we may explain the frequent occurrence of its diseased states. The median nerve is exposed to injury in deep wounds of palm of the hands, in wounds from knives, glass, splinters, etc.

In *The American Journal of the Medical Sciences* for July, 1874, Dr. S. Weir Mitchell reported a case of traumatic neuralgia of the median nerve due to a wound of one of the palmar branches by a splinter. Twenty years after, a bruise of the palm developed intense pain in the course of the terminal branches of the nerve, and the splinter was removed. The pain continuing, three-quarters of an inch of the nerve were excised, with permanent relief to pain. An examination of the exsected nerve showed marked degenerative changes which had occurred primarily in the nerve-fibres themselves.

Of all of the cranial nerves, the fifth is, by reason of its anatomical distribution and relations, most exposed to injury and to morbid changes. Appearing upon the external surface by large terminal branches, at three exposed points it may suffer injury by blows and falls. Much stress has been, from time to time, laid upon the fact of the passage of the branches of the nerve through bony canals and notches, and the contractions of these channels by inflammatory changes have been assigned as the not infrequent causes of painful conditions. A specimen of hyperostosis of the lower jaw in my possession would seem to show that in changes of this character marked contraction does not occur; the hypertrophy in this case was due to syphilitic periostitis, the patient dying of syphilitic gumma of the brain; during life neuralgic symptoms were absent. In cases of phosphorus necrosis of the lower jaw, in which the disease originating in specific inflammation of the periosteum results in the deposit of layers of ossific matter, the foramina of entrance and exit of the inferior dental nerve are not markedly encroached upon, and neuralgic conditions are not a usual accompaniment of the disease according to my observation, which has recently been somewhat extensive. That the presence of the nerve branches,

with bloodvessels in these bony canals, contribute to morbid conditions which have been developed we will discuss further on. It is, I think, in accordance with the conservatism which attends the progress of structural changes to afford protection to the bloodvessels and nerves, in order that nutrition may be maintained.

The direct and extended connections of the nerve through two of its divisions with the teeth, offers, it seems to me, a satisfactory explanation as to the frequent occurrence of neuralgic conditions. The morbid conditions may not only take origin in the ultimate nerve-twigs which take part in the formation of the pulp, but also in the filaments distributed to the alveoli and their vascular and sensitive lining membrane. Inflammation of this lining membrane may occur without accompanying caries, and in this manner we may explain the presence of pain in teeth which are sound, and also the temporary relief which follows their extraction.

Inflammation beginning in the twigs of the pulp and permitted to continue may pass by continuity of structure to the trunk of supply, and gradually involve it. At first, the connective-tissue structures of the nerve become the seat of the inflammatory changes, resulting in hyperplasia and increase in size. The continuance of the inflammatory action results in interference with nutrition, and degenerative lesions are developed. To what extent the interference with nutrition is due to the cutting off of the blood-supply from the accompanying artery by pressure of the abnormally enlarged nerve is a question of interest. And whether the defects of nutrition are entirely intrinsic, resulting from the hyperplastic changes in the nerve itself, is a subject for further study. In the case under examination it will be recalled that the artery, as it lay in the canal with the somewhat enlarged nerve, appeared compressed and its walls collapsed.

The discussion as to the origin of chronic neuralgic affections of the fifth nerve in peripheral or central lesions has taken place from time to time. That grave central lesions in the nerve, or intracranial conditions, may cause intense painful affections cannot be questioned. Dr. Roberts Bartholow, in his *Practice of*

Medicine, states that he has observed the most intractable neuralgia, involving the intraorbital branch of the second division of the fifth nerve, which was found, post mortem, to be due to an intracranial aneurism exerting pressure upon the nerve before its exit. The evidence deduced from the great majority of reported cases, however, confirms the belief that the lesions are, in their origin, peripheral in character.

Another question of interest, which has been discussed in connection with neuralgic affections involving the intraorbital branch, has been the involvement of the ganglion of Meckel and the necessity for its removal in operations. This question, it seems to me, should not demand very serious discussion, and the statements which have been made in reported cases have lacked elements of evidence which should give reason for their acceptance. The cephalic ganglia of the sympathetic system, four in number, are all in relation with the fifth nerve through the sensory roots which this nerve contributes to them. It is possible that the roots derived from the nerve-trunk might become implicated by continuity of structure, but we have no evidence that this involvement of the roots leads of necessity to a morbid state of the ganglion, which differs in structure from the nerve-fibres. Further involvement of the ganglion would induce morbid impressions, which would manifest themselves in the branches of distribution, and we should expect to find symptoms in the cavities of the nose and mouth, which receive these branches largely. Our knowledge of the symptoms expressed in the ganglia of the sympathetic system in morbid states is too meagre to permit the acceptance of the opinion that the painful impressions occurring in neuralgia of the superior maxillary division of the nerve take their origin in the ganglion, and that its removal with the nerve is demanded, in order to secure permanent relief. We do know that the sympathetic system is endowed both with sensibility and the power of exciting motion, but these properties are less active than in the cerebro-spinal system, and are exercised in a different manner.

The propositions which I would submit as the result of the study of the case reported are as follows:—

1. That in the large majority of cases of chronic prosopalgia, the infraorbital and inferior dental branches of the fifth nerve are implicated, and that these branches are involved to the exclusion of other branches of the second and third divisions of the nerve.

2. That as the filaments of these branches terminate in the teeth and the alveoli which contain them, we must look for the initial lesions in morbid conditions of these organs.

3. That these initial lesions are essentially inflammatory in character, assuming the form of an ascending neuritis, and that non-interference with the progress of the action results in secondary degeneration, the ultimate expression of which is that of fatty degeneration.

4. That the diffused character of the pain and the painful spasms observed in the epileptiform variety are due to the extensive connections of these branches with those of the facial nerve.

5. That if involvement of the sympathetic ganglia occurs it is secondary in character, and that we have no positive evidence that independent removal of these structures will afford relief in the treatment, or that their removal with the nerve is essential to permanent relief.

6. That the treatment should be divided into two stages, primary and secondary. It should consist in the primary stages of the removal of the causes by proper treatment, and the employment of antiphlogistic remedies. Destruction of the nerve-filaments and filling of the cavities, or extraction of the teeth and treatment of the lining membrane of the alveoli, should constitute the treatment in the early periods of the primary stage.

Ligature of the common carotid artery as advised by Weinechner and Patruban, and as has been practised in a number of reported cases, should be performed in the early period of the primary stage before the deposit of plastic matter, in order to be of avail. As the vascular supply to the nerve is derived from the branches of the external carotid, it would appear to be sufficient to apply the ligature to this vessel just below the

origin of the facial. Owing to the free anastomosis between the terminal branches of the arteries, it would require ligature of both arteries in order to be completely effective. The ligature of the artery supplying the nerves involved is in accord with a rational method of treatment of the inflammatory condition, and the absence of permanent relief in cases in which it has been employed has no doubt been due to the fact that the operation was not performed at a sufficiently early period.

Stretching of the nerve is an operation which should be performed in the later portion of the primary stage and beginning of the secondary stage, after the deposit of exudates; the purpose being not only to influence the conducting property of the nerve, but to break up the deposit, in order that its removal may be more readily accomplished by absorption. The failure of this method of treatment in cases reported has been due probably to the fact that it has been performed too late, when the ultimate degenerative changes have taken place.

Neurotomy may be regarded as of little or no value in obtaining anything but the most transient relief, the speedy reunion of the divided nerve soon restoring the morbid conditions. The timely depletion which may follow division in the very early stage may be of service, but nothing can be expected, as far as permanent relief is concerned, in the secondary stage.

I have recently had under my care a case in which the effects produced by nerve-stretching were well illustrated, and which may occur in prosopalgia when treated by this plan. The patient, a German, aged thirty-eight, fell in going down stairs, and received a wound of the upper part of the palm of the hand by the breaking of a lamp which he held. Beyond washing the wound, nothing was done in the way of treatment. In a few days it healed, leaving a somewhat painful cicatrix. Gradually the pain extended to the thumb and fingers, and was distinctly felt in the terminal distribution of the median nerve, both sides, thumb, index, and middle finger, and radial side of ring finger. The pain became intense, and the fingers assumed the clawed position, and any effort to extend them gave rise to excruciating pain. Coming to me for relief, I excised the cica-

trix, dissected out the nerve to the extent of an inch, removed a small piece of glass which lay beneath it, and stretched it forcibly; at once this removed a distinct enlargement which existed upon the nerve at the point of wound, and also elongated it. Pain was promptly relieved, and an anæsthetic condition resulted in the area of distribution of the nerve-branches. At the expiration of four months normal sensation began to return, and is now, two months later, perfect. The result in this case indicates that the stretching had destroyed the power of the nerve to conduct painful impressions, and as well, probably, caused a gradual absorption of the infiltrate. This being in time accomplished, the conducting power of the nerve was restored, and the morbid condition being removed, the impressions were normal in character.

Neurectomy is the operation which should be performed in the secondary stage, and when the epileptiform varie y of the disease is present a careful examination should be made, in order to determine, if possible, the extent of involvement, and excision should be carried beyond that point. It should be a rule to leave none of the nerve in the bony canals, and also in intractable cases to carry the operation to the point of exit from the cavity of the cranium. With regard to the second and third divisions, the foramina can be reached in one operation by the method practised by the late Professor Joseph Pancoast. This operation consists in the elevation of the masseter muscle by a square-shaped flap over the ramus of the jaw, resection of the coronoid process, ligature of the internal maxillary artery, separation of the points of origin of the external pterygoid muscle, and exposure of the oval foramen and the spheno-maxillary fissure. At the former the inferior dental nerve can be divided, and after being exposed by a slight incision released at the mental foramen by the surgical burr, and withdrawn entire from the canal. The infraorbital can be hooked down as it crosses the spheno-maxillary fissure, divided, and released at its emergence upon the face in the same manner as the inferior dental at the mental foramen.

If in any case I believed, or had evidence by the symptoms,

or by the appearance presented in the branches of the inferior maxillary division, that the morbid condition had invaded the Gasserian ganglion, I would not hesitate to enlarge anteriorly the oval foramen by the application of the burr attached to the surgical engine, and by traction draw down the ganglion from its position in the fossa upon the anterior surface of the apex of the petrous portion of the temporal bone, and proceed in a cautious manner to break it up or remove by section with the small blunt-pointed scissors. The primary ligation of the internal maxillary artery precludes hemorrhage from either the meningea media or parva, the first of which is in intimate relation as it passes through to the foramen spinosum, and the second as it enters the cranial cavity through the oval foramen. The position of the internal carotid artery as it passes from its canal in the petrous portion of the temporal bone into the cavernous groove should not be forgotten, and great care should be taken to avoid injury to it by going beyond and behind the margin of the oval foramen.

Neurectomy, to be successful, should be complete. Incomplete and partial operations not only result in failure, but destroy the confidence of the patient as to the benefit to be derived from operative procedures. I have ventured to bring this subject before the notice of the Fellows of the Association, and I have submitted the report of the results of the examinations made in the case under my care, with the hope of stimulating further researches into the pathological conditions which exist in this truly distressing affection. It is in this way only, as I have stated before, that it can be removed from the domain of empiricism, in which it rests without hope, and be placed upon the sure foundation of a rational system of treatment.