First saw patient one year and two months after the onset of the disease; there were several internal and external scars and openings where previous incisions had been made. The face was swollen and hard, but the inflammation was not and had not been very severe for a few weeks, the discharge of fetid pus was very great, an abundance of dead and roughened bone could be readily detected and it was easily movable when traction was made upon it with a bent probe.

Immediate operation was advised, the patient was etherized and a long incision made extending from the angle of the jaw nearly to the median line; the left half of the inferior maxillary bone was removed in two large pieces; a number of spiculæ of bone of different sizes also came away during the operation. The largest piece represented the body of the jaw and had connected with it two teeth not completely formed, slightly discolored, dead and not in process of formation, as there was no pulp adherent to them. The other piece consisted of the angle of the jaw, the condyle and coronoid process, and required for its removal sharp traction on the dental forceps, although it was undoubtedly separated from its periosteal cradle. After the removal of the bone mentioned the parts were thoroughly cleansed until no particle of dead bone could be felt at any point.

The child passed from my care after the operation but never had any subsequent attacks of inflammation and no dead bone was discharged or removed after that time, although the purulent discharge continued in decreasing amount for nearly a year. The long continuance of the discharge after all dead bone had certainly been entirely removed, is ascribed to the fact that proper antiseptic treatment was not continued, the parents being unable to persuade the child to undergo any further manipulation or application after the operation.

I have with difficulty been able to induce him to present himself for inspection at this time, over seven years after the trouble has passed away.

He is 13 years old, male. His general health is good, and has been so since the discharge stopped six years ago. During this time two teeth were erupted in addition to those at present in the jaw; one was on correct line but was partly decayed, the other was out of line and grew towards the cheek; the removal of this tooth was not painful but the line tooth was more firmly fixed and caused some pain on its removal. While these teeth remained in position they were a source of irritation, and also had a slight but constant purulent discharge from around their roots; after these teeth were removed, there was a great decrease in the tumefaction of the side of the face.

Inspection discloses a large scar on the neck,

the result of a cervical adenitis which had occurred in the early stages of the disease. The angle of the jaw is depressed and the side of the face is very much sunken at that point and in front of it nearly up to the median line. The lower jaw as reproduced is much shorter from before backwards than it was formerly, the central teeth striking about three-quarters of an inch behind the natural line, as shown by the position of the teeth of the upper jaw.

He has one bicuspid and an eye tooth on the diseased side, and also the central and lateral, which are in correct position; the eye tooth is misplaced, growing forward with most of its root exposed, and is partially decayed, and should be drawn. The bicuspid is in line and in position and seems to be a perfect tooth.

The jaw bone has made a complete reproduction but is composed on the diseased side of a comparatively small amount of osseous tissue; it is very useful, and strong enough for any of its ordinary uses.

The resulting deformity is much greater in this case than in either of the others, the sinking of the cheek and shortening of the maxilla giving the features a peculiar cast.

The study of the cases here reported and the history of other cases considered, indicate that incision and appropriate treatment in the early stages of the disease have a decided tendency to lessen its extent, while early efforts at removal of dead bone before separation has occurred are apt to increase the extent of the disease and resulting deformity, and may lead to a fatal termination.

CADAVER STUDIES ON THE REMOVAL OF THE SEMILUNAR GANGLION THROUGH THE FLOOR OF THE SKULL.

Read in the Section of Surgery and Anatomy, at the Forty-second Annual Meeting of the American Medical Association, held at Washington, D. C., May, 1891.

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The horrible severity of pain in certain trifacial neuralgias is such as to drive the patient to the verge of suicide. Most of them are relieved for a period of one or two years by operations already well known, and a few are cured for life, but the majority relapse, because the neuritis has progressed to the semilunar ganglion, and hence nerve sections and stretchings below that organ relieve only temporarily. I have formerly shown that this relief can be repeated at least several times, by reopening the wound and pulling upon the cicatrix to which the stump of the nerve is attached, thus subjecting the stump and the ganglion itself to repeated stretchings, but I have

little faith that the cure can be indefinitely repeated by this process.

I long ago concluded that the disease, in most cases, commences as a progressive neuritis excited by a decayed tooth, and extends upward into the ganglion itself, and hence that nothing less than the removal of the ganglion will effect a cure in the most obstinate cases. About a year ago, I commenced cadaver studies to see if I could devise any safe operation for the removal of the offending organ. It appeared six months later that Prof. Wm. Rose, of King's College Hospital, London, was independently considering the same question, and since that time he has performed the operation twice on the living subject, with success, thus fairly earning the credit of priority in point of time.

My experiments upon the cadaver, however, have interested me greatly, and throw much light on the best routes and methods of procedure. They also show that about six principal variations are possible in the plan of the operation. Cadaver studies are specially important, in this operation, because we cannot test and perfect the technique upon the inferior animals, since there is no species having a cranial anatomy near enough to that of man to answer the purpose.

The fifth, or trifacial nerve, emerges from the side of the pons Varolii as a rather large flat, striated band, and runs forward over the crest of the petrous portion of the temporal bone near the apex, where it enters an opening in the dura mater. This tough membrane, on the anterior slope of the petrous portion of the bone, divides into two layers, and contains the ganglion between them, so that the latter is, as it were, encapsuled in a flattened cavity of the dura mater about the size and shape of a small Lima bean. The under side of the ganglion lifts easily from the floor of the capsule, having a bursa under it, an arrangement which facilitates separating it from the underlying carotid artery, but the upper surface is very firmly adherent to the roof of the capsule, so that even a curette can scarcely dislodge it. This arrangement adds greatly to the safety of the removal of the ganglion.

Out of this capsule the three branches of the nerve run, and the largest one, the inferior maxillary, passes downward and outward through the foramen ovale, and becomes the guide of the surgeon to the capsule of the ganglion. It is sheathed with a stout prolongation of the dura mater, which withstands pretty strong traction without rupture.

Besides several small twigs, the inferior maxillary divides into two main trunks, the dental and the gustatory.

The semilunar ganglion, or rather the under side of its capsule, lies in part directly upon the internal carotid artery where that vessel emerges obliquely from the petrous portion of the tempo-

ral bone, and its inner border is in close relation with the curve of the artery, where it enters the cranium, and also with the cavernous sinus, so that care must be exercised not to wound these vessels.

Diagram of part of the relations of the semilunar ganglion.

A A A.—Portion of skull.

J.—Condyle and ramus of jaw.

S.—Semilunar ganglion seen edgewise.

C.—Internal carotid artery.

K.—The double dotted line represents that layer of the dura mater constituting the roof of the capsule of the ganglion. The white line between the ganglion and the artery is the under layer or floor of the capsule.

O.—Foramen ovale at exit of inferior maxillary nerve.

D.—Dental branch.

G.—Gustatory branch.

M.—Myloid branch.

This cut is a diagram only, to show certain relations, and not a precise section.

The ganglion is therefore in a very inaccessible location, being inside the skull, near the centre of the cranial floor, and in dangerous relations with great vessels—facts which have heretofore ruled it out of the field of operative surgery.

A closer study of the parts shows, however, that boldness and skill can storm the citadel. The point of approach must be at or near the foramen ovale, but in order to operate in such a location we must, by certain preliminary steps, uncover the parts, so as to see them with the eye, touch them with the finger, and attack them by a precise and unerring use of our instruments.

Fortunately, there are infallible landmarks to guide us to the foramen ovale, as a study of the topography will show.

My studies on the cadaver show the possibility of six forms of operation:

1. Prof. Rose's first operation, which was done by him six months ago. He uncovered the foramen ovale by excising the whole of one superior maxilla, thus getting at the parts from the front. He inserted the centre pin of a small trephine

into the foramen, and took out a button of bone surrounding it, and contrived, through the opening thus made, to extract more or less completely the ganglion.

The base of the skull seen from beneath.

O.—Foramen ovale.

S.—Foramen spinosum, for middle meningeal artery.

P.—Pterygoid ridge.

T.—Place of applying trephine in operation No. 3.

The patient's eye seems to have suffered some injury, for it became inflamed after the operation, and had to be enucleated, but the neuralgia ceased, and at the latest advices had not returned.

2. Rose's second operation was done last January. The method of uncovering the field of operation is very ingenious. Instead of removing the superior maxilla, two perpendicular incisions are made, one a little in front of the ear, and the other at the anterior extremity of the zygomatic arch, the posterior one commencing at the height of 2 inches above the zygomatic arch, and extending as low as can be done without severing the duct of Stenon, or more properly of Stenson. The anterior incision commences at the same height and extends a little lower than the poste-

rior one. A horizontal incision extends along the zygomatic arch, connecting the other two. The zygomatic arch is now sawn off at each extremity, and turned down, carrying the attached masseter muscle with it. This uncovers the coronoid process of the lower jaw, which is sawn off at its base, and turned up upon the temple with the temporal muscle attached.

This uncovers the deeper parts, which are carpeted with a loose connective tissue containing, in most instances, the internal maxillary artery, with many smaller vessels; yet in some cases that artery takes a deeper course, running internal to the external pterygoid muscle. The connective tissue being drawn aside or snipped away, and the artery or arteries ligated, if necessary, the short and thick external pterygoid muscle will be seen, running horizontally from the external pterygoid plate backward to the neck of the jaw. Usually the internal maxillary artery comes out from the inner side of the neck of the jaw at the lower border of this muscle, and winds forward and upward around its external border. Carefully clearing away the connective tissue below the muscle, the large inferior dental nerve will be found, running down from the inner side of the muscle to the inferior dental foramen in the centre of the ramus of the jaw, and a little in front of it, the equally large gustatory branch, on its way to the tongue. These unite higher up into one trunk, which can be traced, with a little patience, up to the foramen ovale about $1\frac{1}{2}$ centimetres forward and inward from the inner border of the condyle of the jaw. By feeling for the sharp edge of the external pterygoid plate, and tracing it up to its junction with the base of the skull, it will be found to lead exactly to the anterior extremity of the foramen ovale, so that we have two guides to the orifice, the great nerve, and the sharp edge of the external pterygoid plate. If the external pterygoid muscle is thick and voluminous, it may become necessary to divide it near the neck and retract it with a suitable instrument, so as to uncover the foramen. The axis of the foramen has such a direction that a line drawn from the centre of the coronoid process upward and inward through the centre of the foramen, passes just beyond it into the centre of the ganglion itself.

The trephine is now applied, but owing to its position being oblique to the floor of the skull, the crown of the ordinary instrument strikes the bone, without the centre-pin being able to reach the foramen, and consequently the saw cannot be steadily worked. To overcome this, the centre-pin must be capable of being protruded 2 centimetres, and have the end round and blunt, instead of sharp, and be withdrawn as the saw progresses, so as to run no risk of entering the skull too far, which would endanger the carotid artery. The centre-pin is also made about one-

half the diameter of ordinary centre-pins, otherwise it will be sometimes too large to enter the foramen. As the crown of the saw advances, the pin is drawn back. Prof. Rose uses a trephine of $\frac{1}{2}$ inch inside diameter, like the specimen here shown. If this is done, it must not be advanced too far, otherwise the inner side of the crown will come directly upon the carotid artery, before it enters the cavity of the skull. When the inner half has cut a little way in, remove the button, and clear away needed portions of bone with other instruments.

View of relations of the nerves.

Z.—Zygomatic arch and masseter muscle turned downward.

T.—Temporal muscle and coronoid process turned upward.

P.—External pterygoid muscle.

N.—Inf. dental and gustatory nerves. Their continuation upward behind the pterygoid is intimated by dotted lines. The emergence of the common trunk for the foramen ovale is at the left of P. and covered by the muscle.

A.—Internal maxillary artery.

The extra length of shaft is to enable the handle to clear more easily the face and jaw, but still the ordinary length can be used.

The ganglion is in the bottom of the hole left by the instrument, and can be removed by curetting and by a small hook-shaped bistoury devised by Prof. Rose, assisted by a blunt hook. The carotid artery lies in contact with the ganglion on the face that looks downward, backward and inward—corresponding to the anterior slope of the petrous portion of the temporal bone. The vessel also curves around the upper and inner border of the ganglion directly in line with the axis of the foramen ovale, so that instruments must not be pushed too far in that direction, for if advanced too deeply, the crown of the trephine will cut the artery.

3. From careful dissection, and experimentation upon the cadaver, I am convinced that the

following plan is better than either of the others:

Reflect the masseter and temporal muscles as before. Expose the external pterygoid muscle, divide it near the condyle, and draw it out of the way with a suitable retractor. You now have a considerable area on the base of the skull, where there is no important organ to be wounded. This is a smooth triangle, having the pterygoid ridge of the temporal bone as its base, and its apex a little beyond and including the foramen ovale. One head of the external pterygoid muscle arises from this clear area, which should be dissected up and retracted, or snipped out. This will give

A. A. A.—The skull.

S.—The semilunar ganglion.

O.—The foramen ovale.

J.—The ramus of the jaw.

T.—The trephine with the blunt center pin in the foramen.

C.—The carotid artery.

you a third guide to the foramen ovale, for if you clear away the tissues from the bone in a direction forward and inward from the inner border of the condyle, you will come unerringly, at the distance of about $1\frac{1}{2}$ centimetre, to the outer side of the foramen, which is an opening about $\frac{3}{4}$ of a centimetre in length, so that it need not be missed, even if the nerve had been torn or cut away by any accident. This clear space is over 2 centimetres in diameter, and affords abundant room for a 2 centimetre trephine, as shown at T, Fig. 2. Backward and outward from the posterior end of the foramen ovale, and at the distance of about $\frac{1}{2}$ centimetre, the middle meningeal artery enters the skull through the foramen spinosum, so that, if meningeal hæmorrhage occurs in the use of the trephine, it can be stopped by pressure of the tip of the finger at this point, or by ligature, or by plugging the foramen spinosum.

Also when the button of bone is withdrawn, the artery can be seized through the trephine

hole, since it lies on the external surface of the dura mater.

pterygoid ridge, and remove a large button of bone. Then raise the dura mater from the floor

Curved and blunt pointed bistoury, modified from that of Rose.

Now apply a medium-sized trephine at the point marked with a black circle in Fig. 2, and carefully remove the included bone, setting the inner edge of the saw within 3 or 4 millimetres of the outer edge of the foramen ovale. Next take a narrow guage forceps and nip away first the isthmus of bone between the trephine hole and the foramen, and then, drawing the nerve outward into the trephine hole, nip away the inner border of the foramen. By a good artificial or natural light, you now see well exposed a pretty large ovate area of dura mater, with the large inferior maxillary nerve emerging from its further portion. The sheath of the nerve here is very strong, so that it can be freely pulled during the further manipulations. Now peel up the dura mater from the floor of the skull under the ganglion, going a few millimetres beyond the locality of the foramen ovale. This lifts the ganglion with the membrane, it being included between the two layers. Next seize the nerve, or the stump of it, near the opening, with narrow forceps, and draw it outward. Dissect off the dura mater from its posterior or further surface of the insertion of the nerve, and you will come into the capsule and the bursa between the gland and the floor of the capsule. Extend the opening of the capsule to the right and left somewhat freely, and with a careful use of Rose's knife or a very small blunt-pointed and curved bistoury, divide the origin of the superior maxillary nerve, and if possible of the ophthalmic branch. The latter lies very close to the cavernous sinus.

Now have an assistant lift the dura mater, while another one draws the nerve inward, and you will be able to open the dura mater and very slowly to dissect the ganglion away from its firm adhesions to the roof of the capsule. This dissection is a little tedious, on account of the firmness of the adhesion, but patience will accomplish it, and if one or more slight cuts occur through this upper layer of the capsule of the dura mater, no dangerous results will follow. Indeed, it might perhaps be well to take curved scissors, and cut out a small circle of the roof of the capsule and take it away with the ganglion, thus shortening the operation. This operation admits of splendid illumination, and enables one to see clearly the steps of the dissection.

4. A fourth method is possible on the cadaver, but less easy than the third. It is to commence as in the previous operation, but to set the centre-pin about a centimetre farther out on the

of the skull, working inward until the ganglion is lifted and the finger feels a large probe inserted into the foramen ovale. Now open the capsule and patiently work out the ganglion, guided by feeling rather than by sight.

5. A fifth plan can be carried out as follows: Leave the zygoma and the coronoid process untouched. Raise a semicircular flap of scalp and temporal muscle from the temporal fossa in such a way that a large trephine can be set on the bone, with its lower edge close down to the zygoma, much as in Stephen Smith's operation for tying the middle meningeal artery inside the skull. Remove the button and, making a flap in the dura mater, insinuate a peculiarly shaped curved spatula under the convolutions of the brain, and lift them from the floor of the middle fossa. The ganglion lies on the anterior slope of the petrous portion of the temporal bone, with its lower edge about $2\frac{1}{2}$ centimetres from the lower edge of the trephine hole. Pass in the finger under the arch of the spatula, run it along the petrous portion to identify the locality of the ganglion by its softness. Withdraw the finger, throw in a strong light, dissect out a circle of the roof of the capsule of the ganglion, and use the hook-shaped bistoury, bent scissors and curette to sever other attachments.

This plan temporarily compresses the brain, and makes some unavoidable contusions and slight wounds of the convolutions, but it is not very difficult. It would be doubtless more dangerous than either of the others, and therefore is not to be preferred in our present state of knowledge.

6. The sixth and last method is to make an incision from the anterior edge of the temporal muscle down to the anterior slope of the coronoid process, and saw off the anterior end of the zygoma. Next saw off the posterior end through a small opening in the skin. Then saw off the ramus of the jaw from the middle of the anterior slope of the coronoid downward and backward to near the angle of the jaw. Raise this flap of skin, muscle and bone as on a hinge, and turn it back over the ear. My first hope was to uncover the deeper parts in this way without sacrificing any bone, but the result was to pry the condyle of the jaw inward, bulging the external pterygoid before it, and effectually covering the foramen ovale from sight; hence, if this plan is adopted, it is necessary to exsect the condyle, draw away the external pterygoid, and divide part of the internal pterygoid, in order to follow the inferior maxil-

lary nerve into the foramen. This and the plane surface of bone external to it being thus exposed, the operation is finished either as in No. 2 or in No. 3. The loss of the condyle is an objection in this case, just as the loss of the superior maxilla is in No. 1. On the whole No. 6, though mechanically feasible, cannot be recommended.

Of the whole six, I give the preference to the third, which uncovers the parts as in Rose's second operation, but applies the trephine at a different spot.

In the two cases operated on by Prof. Rose, the first lost the eye by inflammation following the operation, due perhaps to accidental injury at the resection. In the second case the professor informs me that the eye, three months after the operation, was in good condition, and was recovering its lost reflexes. Both patients were relieved of their pain, thus far, but more time must elapse to demonstrate the permanency of the cure.

As the eye is deprived of sensation, the patient must be taught to care for it and protect it. In the same way one side of the tongue being benumbed, it must be guarded from being wounded by the teeth.

A neurotomy of the fifth nerve on the proximal side of the ganglion can be performed, without removing the latter. If you proceed as in operation No. 3 till the button of bone is removed, and then open a flap in the dura mater external to the ganglion, the convolutions can be lifted, and a knife with a double curve and blunt point can be passed over the crest of the petrous portion of the temporal bone, and made to cut the nerve where it enters the capsule of the ganglion. This operation is possible, but does not seem advisable. It is not best to replace the button of bone in these cases, because a certain portion of such pieces necrose, and the deep location renders the subsequent extraction of the dead fragment difficult.

On the whole, the removal of the semilunar ganglion is a slow and rather complicated operation, but it is not very dangerous. It is to be employed without hesitation whenever a trifacial neuralgia is so severe and so incurable that the patient has no reasonable hope of relief from extreme pain by other measures.

Time only can show how many will be permanently cured. From the nature of the case we should expect that the cured cases would be a large majority, but that in a few the brain itself may be the seat of disease, and baffle our efforts. If the brain is the seat of the trouble, we can usually determine it by the coincident presence of other cerebral symptoms, and thus avoid operating upon hopeless cases.

In making these researches upon cadavers, I am indebted to Profs. Wyllys and Frank Andrews for valuable assistance.

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PERITONITIS, FROM A SURGICAL STANDPOINT.

Read before the Section of Surgery and Anatomy, at the Forty-second Annual Meeting of the American Medical Association, held at Washington, D. C., May, 1891.

BY M. PRICE, M.D.,
OF PHILADELPHIA, PA.

There is no more important subject presented for our careful consideration, or more deserving our most earnest thought, than peritonitis.

It is practically a new field for investigation; few of us comprehend its magnitude, or the importance of the work now being done. Idiopathic peritonitis is a myth and a delusion. The error has been that symptoms have been mistaken for the disease, and when relieved, a cure is accredited to some special form of treatment. Vomiting and tympanitis with pain does not necessarily indicate peritonitis.

There are many conditions of the digestive tract that will give all these symptoms, yet no peritonitis be present. And you may have peritonitis without pain, without tympanitis, in fact, almost devoid of symptoms, yet have many ounces of purulent fluid in the peritoneum.

Peritonitis always has a cause, and if the case be properly investigated, we can find it. For so serious a condition, it is one of the most curable diseases we are called to treat. That is, if we investigate the cause, and remove it. And then again, it is most wonderfully submissive to bad treatment. Improving again and again under the opium treatment, which is the worst of all, for it blinds the practitioner to the dangerous forms when they do appear for proper treatment, and where nothing but the proper treatment will save life. I marvel at the great credit men give to the opium treatment of peritonitis. And when recovery takes place, credit all to their treatment, with not one thought of the wonderful protective power of nature to guard her inner work.

Have they treated the condition, the actual disease, the exciting cause? No, in most cases they have not even investigated to find the cause; but have contented themselves with the thought that their patient is now all right, notwithstanding the fact that the patient suffers repeated attacks, until there comes a time when the operating table or the post-mortem table reveals to the wondering practitioner a cause. Thanks to the surgeon, we do not have to resort to the post-mortem to find what has given our patient peritonitis, or the way for their relief. I purposely avoid quotations from standard works; all of you are familiar with them, and as most they say does not interest us at the present day, I will not trouble you with either their pathology or their so-called treatment, with opium as their sheet anchor. I except those writers of a century ago: Dewees, and that great teacher and writer, George B. Wood. How strange that medical men are so