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ORIGINAL COMMUNICATIONS.

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THE TECHNIQUE OF MAXILLARY SINUS OPERATIONS.*

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The Maxillary Antrum consists of a cavity pyramidal in shape, having four walls; the apex directed outward; the base or inner wall, corresponding to the external wall of the inferior and middle meatus of the nasal fossa.

The antra are nearly symmetrical in the same subject, but in certain instances, septa may be present with ostia of communication.

Gruber¹ reports having encountered a complete septum in five cases in two hundred examined, one being bilateral.

Sieur and Jacob² found no complete septum in their report of one hundred and fifty cases.

Zuckerkindl has reported a case where there existed two cavities communicating with the nasal cavity by separate ostia, but not with each other.

Small ridges of bone or semi-lunar diaphragms of fibrous tissue are often encountered obtruding the angles of the antrum, which become of great surgical importance. The prolongations of the angles are sometimes closed by a thin bony lamina having a small ostium. These accessory recesses are only discovered by most careful investigation of the corners. Their escape from observation has rendered futile several operations, as reported by Luc and Lermoyez.[†] A

* Read before the ninth annual meeting of the American Laryngological, Rhinological and Otolological Society, Lexington, Ky., May 1, 1903.

¹ Virch., Arch., Vol. CXIII.

² Sieur & Jacob, Recherches sur les Fosses Nasal. Paris, 1901.

[†] S. & J., loc. cit.

reinfection of the sinus after a radical operation should always lead us to a suspicion of the existence of one of these retention crypts. The angles sometimes take the form of horns extending upward at the expense of the orbital wall. In one case in my own practice I found that the anterior superior angle communicated directly with the frontal sinus of that side; there being two distinct openings in the floor of the frontal sinus and no apparent opening into the nasal cavity through the wall of the abnormal antro-frontal canal.

Leaving the consideration of the angles we find that various bony ridges traverse the walls. The most constant ridge is the containing wall of the superior maxillary nerve and artery which cross the orbital to emerge at the superior border of the anterior wall. This ridge when very pronounced makes pockets on either side, often difficult to curette.

The ridge itself is very thin and must be handled with great delicacy in the surgical work of the antrum. Pressure on the nerve trunk by retained pus, or an osteitis of the canal wall, undoubtedly explains the great pain often encountered with inflammation in the antrum. The anastomosis between the lachrymal branch of the ophthalmic (Willis') and the orbital branch of the sup. maxillary given off within the canal, will account for the disturbances of lachrymation frequently noticed in empyemas of the antrum.

While nerve lesions may arise from pus entering the canal, on the contrary Langenbeck* cites two cases in which a resection of the infra-orbital nerve produced an infection of the antrum.

The Internal Wall is interesting from a surgical standpoint, in that it collaborates the external wall of the lower and middle meatus and is crossed obliquely from before backwards and above downwards by the insertion of the inferior turbinate bone, which may be said to divide this wall into two triangles, of which we will speak later. From the anterior attachment we first find the thickened ridge containing the nasal duct or lachrymal canal, occupying the anterior fourth of the wall. Directly behind this in the middle meatus we observe the natural orifice of the antrum, the *ostium maxillare*.

In the inferior portion, the wall limiting the inferior meatus, is composed of thin bone. The superior portion corresponding to the wall of the middle meatus is at first bony, but behind the ostium, for three-eighths to five-eighths of an inch, it consists of membranous tissue, only strengthened by the uncinate process of the ethmoid. Finally the wall meets the maxillary and ascending processes of the

* Arch. f. Klin. Chir., 181, 9.

palate bone and for the last three-eighths of an inch becomes bony once more. The wall in the region of the middle meatus is so delicate that it is easily penetrated by the little finger. In operating, a bistoury readily divides the slender uncinatè process.

Plate 1. Showing operative schematic plan of internal antral wall. C. Center of opening through canine fossa. L. C. Cribriform plate. S. Sphenoid sinus. O. M. Ostium maxillare. D. Region of the lachrymal canal. Both turbinates have been removed and also the internal lamina of the ethmoid with the middle turbinate, to show the ethmoid cells. The angle A, C, P, equals 45° . L, C, C, P equals 90° . A. Anterior wall of sphenoidal sinus. The distance C. A. equals 2 inches (5 c.m.). C. L. C. equal $1\frac{3}{4}$ inches (4 c.m.). B. Posterior limit of cribriform plate which forms the roof of the nasal cavity between the lamina perpendicularis and internal lamina of the lateral mass of the ethmoid.

Middle of canine fossa to anterior wall of sphenoid, 2 inches (5 c.m.). Middle of canine fossa to cribriform plate, $1\frac{1}{2}$ to $1\frac{3}{4}$ inches (4 c.m.).

It should be remembered that the descending branch of the sphenopalatine artery is in relation to the ascending portion of the palate bone, and, in curetting and chiselling in the posterior border, this must be borne in mind.

So easy is it to dissect the inner wall from its superior attachment it would seem that Nature had intended to leave this gateway to the posterior ethmoid cells and the sphenoidal sinus *via* the maxillary antrum. Through this route Jansen makes his bold journey, as does Luc and other operators. The best view of the sphenoidal wall is thus obtained.

Mosher* gives the distances from the canine fossa as follows, 50 heads average:

After the anterior wall is well removed in the radical operation, a sinus lamp introduced into the nose will show the insertion of the inferior turbinate bone. We observe that this line of insertion does not divide the quadrilateral base into two triangles; but that the posterior insertion is about $\frac{3}{8}$ of an inch above the post. inf. angle of the internal wall. For all practical purposes, however, we may consider this a triangle and remember that the antero-inferior triangle has to do with the inferior meatus and the post. superior triangle with the middle meatus. This superior triangle presents to us points of especial surgical interest. Through this triangle which is so easily broken down in its centre we have the anatomical bearings as follows: After breaking the antrum wall the infundibulum or the gutter of the unciform is entered. The Bulla presents itself in the meatus above the entrance of the curette. The space between the Bulla and the unciform is called the Hiatus Semilunaris. Above and anterior to the curette are the anterior ethmoid cells, made up of their uncinate and lachrymal walls. These cells vary in number from 3 to 5. By breaking down the Bulla, we are in relation to the anterior cells situated further back, by some authors called the middle group, whose ostia open into the gutter of the Bulla. Sometimes the Bulla contains a cell which opens into the superior meatus, but usually all the cells open into the antero superior extremity of the gutter of the Bulla. One of these two or three cells which make up the pyramid of the Bulla, may make an excursion into the frontal sinus, or above the orbit at the expense of its superior wall. Very frequently† the bulla is made up of two anterior and one posterior ethmoid cells. While these two groups of cells are often independent, they may communicate with each other. From a clinical standpoint infection of the whole group is facilitated from the fact that the gutters of the uncinate and Bulla approach each other anteriorly. The curette passing backward but in a horizontal plane, may now be interrupted by the middle turbinate, which we remove and disclose the posterior ethmoid cells. These cells number from three to four and open into the superior meatus in its anterior portion. The cells may be classified as superior, postero-inferior and bullar in that the latter corresponds to the base of the bulla ethmoidalis. The postero-inferior cell is in intimate relationship in the external half of its posterior wall with the sphenoidal sinus and sometimes communicates with it.

* THE LARYNGOSCOPE, Vol. XIII, No. 3.

† Sieur and Jacob say that they have found this condition to exist in 60 of 100 cases examined.

The optic nerve is in close proximity to the cell wall. These cells may extend into the lesser wings of the sphenoid or, like the anterior cells may make excursions toward the cranial cavity, the orbit, or into the middle meatus.

Next in sequence we come to the sphenoid, which, should we choose to enter in this manner, viz., through the canine fossa, antrum and middle meatus, would be the object of our attack. So much for the posterior superior triangle; the inferior triangle will be considered later on.

The floor of the antrum corresponds to the alveolar process anteriorly and posteriorly presents a curved wall which loses itself in the posterior wall and roof.

The floor over the dental region is often intruded by prominences representing the roots of the teeth. Care should always be taken to find out whether there is inflammation at this border. The apex of this rather schematic pyramid looks toward the zygomatic fossa and presents no especial point of interest.

Lastly we come to a consideration of the anterior wall, which presents a convexity situated between the canine and molar ridges, corresponding to the depression in the superior maxilla known as the canine fossa. Through this fossa entrance is made, as will be described later, for the radical antrum operation, as well as for the various operations upon the ethmoid cells and the sphenoid sinus.

Having briefly described the antral cavity, let us now consider the means employed to perform the so-called antral operations and discuss their relative merits.

Having determined that a pus discharge is established from one nostril; possibly confirmed by transillumination to be from the maxillary antrum, we seek by elimination of contributing frontal sinus trouble to verify the diagnosis. To do this we must find out if there is pain or tenderness on pressure, over the frontal, or orbital wall of the sinus of the corresponding side, or if on stooping to the floor there is a sensation of pressure, pain or fullness in the region of the eyebrow. Having satisfied ourselves that the antrum disease is not a secondary complication of a frontal sinus inflammation, or of disease of the anterior ethmoid cells, and that the cavity has not become merely a reservoir of pus from above, we seek to determine the following points:

- 1st. Is a diseased tooth the cause of the antrum trouble?
- 2nd. Is the discharge of recent origin (acute), or,
- 3rd. Has the suppuration been of so long standing that the mucous lining of the sinus is affected (chronic)?

It is the determination of those points that indicates our choice of treatment.

Let us first determine if the second bicuspid or the first or second molar is diseased at the root. If there are indications of decay or a dead tooth, we must decide whether it is not better to remove this possible source of inflammation, even if after exploratory puncture through the socket we decide upon a radical operation through the anterior, or inner wall of the antrum. If we have an acute case to deal with, before we perforate we should always attempt to wash the cavity through the natural orifice, for in about three cases in ten we are able to do this by means of a Hartmann canula passed about $4\frac{1}{2}$ centimeters from the vestibule. The ostium maxillare is usually situated near the anterior angle of the middle meatus.

By passing the canula through the hiatus semilunaris and along the outer upper wall of the meatus we may engage the tip and by turning the shaft slide the curved end into the antrum, I have found the hand piece of the Alpha No. 2 syphon douche the most convenient attachment for antrum tips, as it is very light in weight and of the same shape as a Davidson family syringe.

If we can secure resolution and resorption in ten days' washing we may not require further operative treatment. If, however, the pus continues to appear in the finger bowl, held under the nose in douching, and we have pain and evidence of inflammatory changes in the mucous lining as evidenced by transillumination, we must decide upon another method of cure.

Provided it is impossible to wash the antrum through the natural orifice, we must trephine or drill through the alveolar process of a tooth which we have extracted, or through the socket of a lost molar or bicuspid.

This procedure, however, is only to be thought of, when we suspect the root of a tooth as a possible complication, otherwise we may make an exploratory puncture through the middle meatus wall, the inferior meatus wall, or through the canine fossa, and try to cure the acute disease by irrigation.

I have found Tr. iodine 3 i, acid carbolic 3 ss, Sat. sol. boric acid q. s. ad. O i, an excellent irrigation solution during the acute stage, to be reduced finally to saturated boric acid solution. The question as to how long a time we should permit our patient to attempt a cure by irrigation is a very difficult one to solve. It in a great measure depends upon the temperament of the person. I have had a case of long-standing antrum suppuration, where the pus evacuated by

an alveolar puncture was most offensive and suggestive of extensive degeneration of the membrane, become entirely healed after eighteen months of constant irrigation. The gentleman, aged 40, was of excessive nervous temperament and absolutely refused a radical operation. It is now two years since his recovery, and the antrum is perfectly normal. The man wore a hard rubber peg which he kept in place by a piece of chewing gum or absorbent cotton pressed between the teeth. These pegs are very convenient; they may be filed down, and polished by being rubbed on the surface of a prescription pad. The best obturator for an exploratory puncture in the canine fossa is made by rolling up a half-inch square of a sheet of dental gutta percha and flattening the end into a kidney-shaped shield, which while soft may be made to fit the irregularities of the gum, before being plunged in ice water. The peg should be half an inch long, inserted at the top of the shield and curved slightly downwards.

Plate 2. Pegs.

One should learn to manipulate gutta percha both for nose and antrum work, for the pegs are always requiring attention and alteration in shape—and the ends are apt to disintegrate and break off, if worn too long. It is quite easy to make obturators of these shapes by simply putting the sheet in boiling water, then wrapping around a pencil, welding and cooling. You can thus make tubes, or else mould into any solid shape required. A plug like this, to fit the trephine hole is made in a moment, and a few extra ones may be given to the patient.

If used in an alveolar bore between two teeth near together, the base of the plug may be made to fit the cavity left by the lost tooth. In a short time you can make any nasal splint required for the correction of a deformity, or to be used as a support after an Asche or Gleason operation.

I go into these details, for the books do not always give the commonplace minutiae of a subject. I once had the honor of taking off my hat to a man who had chased a goose, made a tube of a quill, and

performed a tracheotomy with a penknife, all within forty seconds. This, however, does not lessen my respect for a man who has struggled with a maxillary antrum suppuration for several years. In my opinion the day will come when the bacteriological examination of the discharge will largely influence the selection of operation.

Many of us who have had experience, have seen cases get well after a simple puncture and a very few irrigations, cases too, which have been considered chronic.

Then, again, seemingly acute cases have gone on discharging after the same treatment and we have finally done a radical operation, only to find in the end a struggle of many months' duration before we could effect a cure. So far we have spoken simply of a puncture. Many articles written will say that the alveolar puncture is for drainage; this should never be the case; the puncture is simply made to investigate the condition of the antrum and if the nature of the discharge and feel of the walls warrant us in supposing that we may cure our case with irrigation, the puncture becomes the socket of our irrigation syringe tip. The cavity is syringed with the head bent forward over a finger bowl, a pint of solution being passed through by means of the rubber syringe above described.

I have mentioned a glass finger bowl as the best and most convenient method of catching the discharge as it comes out of the nostril. It is a good custom from time to time to decant the water and apply peroxide of hydrogen to the pus and debris, in order to verify true suppuration and watch the activity of effervescence, for the study of this activity is useful in determining the retrogression of pyogenesis. On one or two occasions I have been surprised to find that a grumous mass gave no pus reaction whatsoever, a proof that it had evidently come from the nostril and not the antrum.

In boring through a socket from which a tooth has been extracted some years previously, and where we expect to encounter perhaps a quarter of an inch of solid bone, we should take a trephine of a large size at first, changing as we proceed to those of lesser calibre. In this way we avoid heating our bone and choking—possibly breaking our drill or trephine. After the antrum has been entered, we can easily ream out the bore by running through a larger trephine. In boring for the cavity in this way, it is best to always bear in mind the direction to the antrum, for with a high palatine arch, we often find a very narrow alveolar process. From the bicuspid region we must bore slightly backward and outward, to escape the external inferior meatus wall, which is the inner wall of the antrum. From the region of the molar ridge we must bore inward and backward

preferably through the palatine root socket of a molar. Care must be taken in entering the cavity that we do not allow our drill to slip as we enter, and go on to penetrate or injure the orbital wall.

If we are to rely on the irrigation treatment, we must have a generous opening into the antrum. If we have been fortunate enough to discover the tooth whose root has caused our trouble, we may enter the cavity by simply a pressure on our drill; at other times we will find ourselves in an ivory-like jaw very difficult to penetrate.

For many reasons, if we do not suspect the teeth, we should turn our attention to other modes of attack.

The easiest entrance, of course, is through the middle meatus whose membranous wall in the region of the ostium maxillare can be penetrated by the little finger, after we have removed the anterior tip of the middle turbinate. That this method of treatment of antrum suppuration has been successful is proved, by its having advocates who believe in making as large an opening as possible in this meatus by means of a hook-shaped bistoury and the finger. Drainage takes place when the patient is prone and lying on the other side; irrigation is easily performed, and ventilation good, which is the only thing in my mind which recommends this procedure. Curetting of the cavity is very difficult and packing unsatisfactory. No less an authority than Zuckerandl at one time advocated this procedure, but our plans and views are changing with the evolution of the proper accessory sinus treatment, and it is hardly fair to a writer to brand any procedure with his name, for the simple reason that he has described it as a method years ago.

Next we will consider the canine fossa as a point of entrance. In this location it is very easy to penetrate the antrum with a trephine and do the irrigation treatment in the same manner as through the alveolus. Care must be taken to make the bore a centimeter above the junction of the gum and the tooth, for we must not injure a root, nor on the contrary must we go much above this limit without investigating whether we are liable to injure the infra orbital nerve and artery which generally are found to emerge from the canal in the wall of the antrum, at a distance of $1\frac{1}{2}$ centimeters above the point of attack mentioned.

In making this puncture with the electric trephine, the patient should be lying down and the cheek retracted by an assistant. The mucous membrane of the fossa, which previously has been cocaine'd and adrenalized, should be slit horizontal to the teeth and elevated sufficiently with a periosteotome to allow an $\frac{1}{8}$ -inch trephine ample space to make three perforations in the form of an ace of clubs.

This hole may be rounded and smoothed as to the edges and a gutta percha plug made to fit it, as soon as the swelling of the membrane subsides—that is, provided one wishes to try this ancient and honorable means of cure by irrigation, without examination and treatment of the sinus walls.

These methods are described for the benefit of the timid members of our cult, who should be characterized as the spraying rhinologists. These nimble-fingered specialists condemn all methods which cause pain; they reduce enormous tonsils by absorption with astringents, and remove adenoids with spray. Frontal sinuses and antra do not disturb these gentlemen, for they refer the patient back to the gen-

Plate 8. Sinus Lamp.

eral practitioner for the cure of the frontal neuralgia and the tic-douloureux, while they still continue to treat the "catarrh." Apologizing for the slight digression, I will proceed. We have made our exploratory opening, the timid practitioner goes no further; he is satisfied to risk irrigation. He does not probe to see if a pyogenic membrane fills it, or whether polypoid material invades the cavity. If it is only an acute case, he cures it by washing through the alveolar or fossa puncture, but unfortunately—and this is a point I want to strenuously emphasize—too many specialists are doing this kind of work as a routine practice without regard to the chronicity of the case. Let me put the question differently:

Should the fact of an isolated case like the one I have described above, in which eighteen months' syringing effected the cure of a chronic condition, prompt any of us to try for so long a time to cure a patient? My answer is emphatically no.

Having made an opening in the canine fossa, we are in a position to make a diagnosis which the alveolar opening does not allow. We first inspect the walls of the sinus by means of sunlight and an ear speculum, and then with a flexible ring curette, we cautiously feel all the angles and touch all the prominences of the walls in search of granulations. A sinus lamp in the nose illuminates the antrum for the examination of the walls in a very beautiful way, provided we have no sunlight. After we have examined the walls in a thorough manner, we now bend our curette and using the dull side of the ring, go carefully over the floor to see whether any of the teeth have intruded or whether any dentigenous cyst is present. Provided we have found nothing, and better, if we can trace the empyema as a sequel to some grippe or acute process, we may consistently irrigate, leaving a gauze drain for a day through the perforation, before introducing the plug. If, on the other hand, we find the walls unhealthy, granulation tissue present, lining membrane bleeding readily to the probe touch, odor to the discharge, hypersensitive walls, etc., we decide at once on doing a radical operation. This must be done under an anæsthetic.

There are three operations to-day which are in evidence, and which I will discuss:

- 1st. The operation through the anterior wall.
- 2nd. The operation through the anterior wall with a nasal fenestration left for dressing, removal, drainage and lavage.
- 3rd. The radical operation through the inferior meatus.

We differentiate between the simple and radical operation, in that the radical by a large opening permits free inspection, surgical treatment and dressing of the entire cavity from without.

When we have decided upon a radical operation, we must first tell our patient that an estimation of the length of time which must elapse before they are cured is exceedingly problematical. We can promise our patient, however, that the disease will be no longer annoying; that there will be no odor; no discharge except in syringing, and that after a few days he can care for himself. If the first or second operation is decided upon, five days in the hospital or at home will be necessary. If the third method is employed, but one to three days generally suffices. Much more swelling of the face takes place

when the anterior wall is operated upon than when the meatus wall is the point of attack. This swelling is often kept up by redressing for several days or even weeks. Edema of the eyelids is often a complication, to as great a degree as in a frontal sinus operation, but this lasts but a day or two. Could we but promise our patient that he would be absolutely free from discharge, after operating by the first method, we would always recommend it. Unfortunately, that little bead of pus which disappears and then reappears in the finger bowl on douching, makes us afraid to close the wound, and we always anticipate that the patient will re-infect the sinus by a fresh cold if we allow the orifice to heal, with no means of drainage except through the ostium maxillare. A recognition of these unpleasant features has evolved the second operation known as the Luc-Caldwell, which is much more satisfactory from a drainage standpoint after the removal of the packing gauze. From the fact also that the cavity is thoroughly aerated, the conditions are more favorable for the production of a new membrane.

Another thing which recommends the Luc-Caldwell operation is, that the occasional little pearl of pus in the washings is not an ever-present phantom in the mind of the patient, and a discouragement to the doctor. This is really a serious objection to the first operation, for it is often impossible to ascertain whether the pus has arisen from the cavity of the antrum itself or has trickled in from an empyæmic ethmoid cell. I should always advise in the first operation enlarging the natural opening to the nose in the middle meatus and curetting the adjacent ethmoid cells to guard against this possibility.

The technique of the operation through the canine fossa is as follows: Having etherized the patient, place a cork between the teeth of the opposite side and some rolled gauze in the cheek outside of the teeth of the lower jaw on the side of operation. Now make an incision to the bone about an inch and a quarter long, from the molar ridge to the canine eminence a centimeter above and parallel to the junction of teeth and gums. The cheek is held back by three retractors while this incision is made.

The periosteum is now elevated above, and slightly below, and the two retractors above are changed to include the periosteum, which procedure stops in a moment the sometimes rather free bleeding.

Whether we have previously made a trephine opening or not, we employ a mallet and chisel and enter the antrum through the canine fossa, making an opening large enough to permit the blade of a bone forceps to enter, when we may complete the fenestration to any size

we may desire. Generally a centimeter high by one and a half long is the usual extent of space we may try to obtain, but this depends on the size of the face and the antrum. We may find a huge antrum in a small face and *vice versa*.

As soon as we have penetrated the cavity we quickly probe and get an impression of the size of the sinus. The entrance of the probe gives us an idea of the contents as well. Generally, however, we are obliged to bite off with our forceps enough bone forward and backward to enable us to quickly pack the sinus after a swab or two and wait for the bleeding to cease before we complete our fenestration. After one or two minutes we may take out the packing gauze tape and begin to curette the cavity in a general way. When it refills too rapidly with blood, repack for a moment. As we go on, the bleeding becomes less and less, so that an assistant may only occasionally be required to swab the overflow while we are removing all the unhealthy granulations. It is a good plan to use adrenalin solution on the gauze used for the first plugging.

As we clean the cavity of its degenerated membrane, the bleeding ceases and we may finish with great nicety in a clear field, should we wish to do so. I generally content myself to remove the masses and everything of a velvety feel, and rely upon pure carbolic acid applied with a cotton swab to the minute recesses I may find in the angles. The acid is neutralized in half a minute with a swab of absolute alcohol. Remember that the antrum wall is apt to be very thin and often broken down in old cases, so we must use no force in curetting, but rather rely on a sharp spoon and the flexible ring curettes.

If we wish to go no further we clean our cavity thoroughly, swab with peroxide of hydrogen 1-4, or bichloride solution 1-5000, and pack the sinus with iodoform gauze which, if there is no odor, and the patient has no temperature, we do not remove until the fifth day. Washing out the cavity after this with anything but normal saline solution is harmful to the granulations. The packing must be put in, in such a way, that the lips of the wound are held apart, for the membrane here is very quick in healing and our orifice becomes rapidly smaller and smaller. When the walls of the cavity are covered with good red granulations, which condition usually occurs in about ten to fourteen days, gradually substitute worsted for gauze, for it packs through a smaller orifice and we may allow the wound to heal up to fit any obturator we may have prepared for it.

Now comes the rub. If we pack our cavity for too long a time, we may do an injury to the synthetical granulation metamorphosis.

If we withdraw our dressing too soon, the granulations may break down very quickly and we must begin all over again. It requires a practiced eye to tell by the peculiar color of the granulations just when to stop dressing. When we are satisfied that the very red ambitious granulations pervade the entire walls, we may cease the wool packing and put in our peg. This period is generally from two to four weeks from the date of operation.

We leave in the peg except when we syringe and begin to wash the cavity with normal salt solution as has been described, praying that the granulations are turning into a normal mucous membrane. From this point on, the procedure is unsurgical. If we leave in the peg, the cavity may become reinfected from the mouth at any moment. If, on the other hand, we take it out and allow the antrum to close, we may be unaware of any trouble until the antrum is in nearly as bad condition as before, and the work has to be repeated.

I cannot absolutely condemn this method, for I have obtained brilliant results from this operation, but I must say the operations to be described appeal more favorably to the surgeon's instincts. The second method, known as the Luc-Caldwell operation, is undertaken in the same manner as has just been described, with the exception that after the cavity of the antrum has been curetted through the canine fossa, and all the debris removed, we make an opening into the inferior meatus. This is best done by means of a trephine or chisel and enlarged by a Grünwald cutting forceps. A strip of gauze should be packed into the nasal fossa posteriorly before the opening is made. The fenestration is made about a half centimeter above the floor of the cavity, which is on a level with the nasal floor, care being taken that the opening is about a centimeter posterior to the anterior insertion of the inferior turbinate. In this way the fenestration is posterior and inferior to the opening of the nasal duct, which is at the roof of the meatus. The larger the nasal orifice the better will be the ultimate result. The inferior turbinate, if impinging upon the floor or external wall of the nasal fossa, should be removed anteriorly, with trephine and snare, sufficiently to give access to the opening in the wall. A burr drill should be used to smooth the lower edge of the opening and leave as little ridge as possible between the antrum cavity and the nasal floor. After the bleeding has been arrested by adrenalin, the antrum is loosely packed with iodoform gauze tape, or wool, in such a manner that the end may be passed through the nasal orifice. The wound in the canine fossa is now closed by two or three sutures, including the periosteum with the membrane of the superior flap.

A gauze pad wrung out in listerine, 1-3 solution, is retained over the wound by the pressure of the cheek. This pad should be changed every two hours. On the fourth or fifth day the gauze or worsted wool is removed through the nasal orifice, under gas if practicable, and the antrum washed with boric acid solution if any odor is present, or, with normal salt solution, or artificial blood serum if there is none. (Fraser's saline infusion tablets, 1—O i). Powdered aristol may be blown into the antrum should we wish. There is this to be said about a nasal orifice: If the case does not seem to be doing well, with little inconvenience to the patient, we can make swab applications to the walls of the antrum through the nose with zinc solution, protargol and other silver salts, iodoform, etc.

If the patient is so situated that washing out the antrum is impossible, the sinus will drain into the nose and we need not fear the consequences of retained secretion.

In many cases, after a few irrigations, the simple unilateral blowing of the nose seems to cleanse the sinus sufficiently, so that we may do away with syringing altogether.

In case the orifice becomes small, we may ream it out with a barrel burr drill after an application of cocaine and adrenalin.

The opening in the canine fossa need not be as large if we contemplate the Luc-Caldwell operation, instead of simply opening the anterior wall. Jansen and Hajek operate on even broader lines. The former removes as much of the nasal wall as possible, dissecting the middle turbinate from within the cavity of the antrum, leaving the nasal membrane intact as a flap, the corners of which he sutures to the superior margin of the sinus and the region of the first molar. In many cases in which I have seen him operate, he invariably opened the sphenoidal sinus to ascertain if it contained pus. This was done by means of a long chisel through the region between the ostium maxillare and the palate bone; the removal of the middle turbinate and the breaking down of a few cells, giving a very clean channel to work in. This daring operator makes use of the burr drill very extensively in smoothing partitions and exploring the angles of the accessory sinuses; we may learn this lesson from his work, his results show little pus but extensive deformity.

We come now to the consideration of the operation through the inferior meatus, which recommends itself in that no anæsthetic is necessary for its performance. This fact alone renders it applicable to many cases where the idea of a serious operation under ether is objectionable to the patient. It is surely the operation to be selected in cases of weak heart—and weaker courage.

The operation is performed as follows: The inferior meatus is packed with a pledget of absorbent cotton, saturated with a half-and-half solution of cocaine, 10 per cent, and adrenalin chloride solution (1-1000). The inferior turbinate is covered externally and internally from its middle portion anteriorly. It is a good plan to fortify the patient with an ounce of whiskey, 1-25 gr. strychnia sulph. and 1-15

Plate 4. Showing trephine over the situation of the proposed fenestration, before turning outward 45°.

gr. digitaline before operating. After the cotton has remained in contact with the turbinate and external wall of the meatus for ten minutes, we take a 1-8 in.—3-16 in. trephine, run by an electric motor or dental engine, and remove by a couple of perforations, followed by the cutting forceps and snare, the anterior third of the inferior turbinate. In this manner we clear away the body to its line

of insertion. This procedure is almost bloodless. The outer wall of the meatus is now brought into view. It will be seen that the trephine may be employed to perforate the inner wall of the antrum about a centimeter beyond the anterior point of attachment of the inferior turbinate just removed, the shaft of the trephine entering the nostril at an angle of about 45° . I prefer to make the perfora-

Plate 5. Showing perforation completed for radical operation on antrum through the inferior meatus.

tion at a point a quarter of an inch above the nasal floor for the bone is thinner as we ascend the wall.

Having punctured the antrum, we immediately change the trephine for an olivary or barrel burr drill and enlarge the orifice upward, downward and backward. We then stuff into the orifice some gauze wet with adrenalin solution, 1-5000, which quickly stops any bleeding that may occur. By using properly-curved flexible ring curettes, we are enabled to reach the walls of the antrum very satisfactorily.

The bleeding does not annoy the patient, as the head is so held that it escapes anteriorly. Orthoform or cocaine may be used to limit pain, or, if we so decide, the curetting may be postponed until another day.

I have recommended the trephine as the instrument to be used, not because it is my own suggestion as applied to nasal work*, but because in no other way can the outer wall of the meatus be so quickly and smoothly perforated. The edges of the fenestration must be

Fig. 6. Trephines.

very free from bony spiculæ to facilitate dressing. It is very easy to pack the antrum with the iodoform wool prepared by Van Horne. My experience has been in a few cases so very successful, that I am inclined to urge this method of operating upon the society, for even if we did not attain a rapidly favorable result, we have established a fenestration into the nostril which will not be out of place, if in future we decide that a more intimate curettement of the cavity should be advisable through an opening in the anterior wall.

Fig. 7. Barrel Trephine.

In view of the frequent recurrence of antral suppurations, and from the fact that an antrum may become at any time a reservoir of pus and infected from acute ethmoid or frontal sinus suppuration, may we not consider it the very best practice to establish a permanent drain for so insanitary a locality. Could we but hope for a total obliteration of the antrum, with granulation tissue, by persistent packing through any opening of the walls, it would be the ideal treat-

* The Nasal Trephine and its Advantages. *N. Y. Med. Journ.*, May 28, 1887.

ment. I have never seen but one case in which this occurred—and that was in a patient the zygomatic wall of whose antrum I was forced to entirely remove on account of its necrosed condition. This was the most diseased antrum I ever encountered, but nevertheless the fatty tissue from the zygomatic fossa invaded the antrum and it entirely filled up with solid material and is to-day obliterated.

My apology for having entered perhaps upon unnecessary detail in writing on this subject, will find its excuse in the perusal of such an article as appears in the *Virginia Semi-Monthly* of April 10th, 1903. This article, which represents, from the standpoint of a dentist the present treatment of antrum suppuration, is a sorry commentary upon the knowledge many dentists possess of this important subject. Many of us have seen the gold tubes banded permanently upon an adjoining tooth, through which a few drops of antiseptic solution are injected daily into the antrum by means of a hypodermic syringe. On one occasion I have seen the antrum treated by means of a fine tube which had been inserted through the root of a bicuspid. I am sure none of us have an opportunity of seeing the number of cases of antrum trouble that must come under the observation of the dentist, and no one should be able to recognize better than a dentist, that the treatment of empyema of the antrum of Highmore belongs to the rhinologist rather than to himself.

In closing these observations I will state that they are the deductions from an experience of some fifty cases upon which I have operated, the review of which I trust will be of value to some of us who are working upon this most interesting subject.

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