

THE RELATION OF THE LATERAL SINUS TO THE MASTOID OPERATION.*

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As we all recognize in the lateral sinus, with its irregularity of course, one of the greatest dangers that we encounter in the performance of the mastoid operation, a study of the relations of the sinus to the mastoid bone is always of more than ordinary interest.

From the standpoint of the otologist, the horizontal portion of the transverse or lateral sinus, that portion extending from the torcular Herophili to the knee, is of little interest. However, below the knee, that point where the horizontal portion makes an angular turn to become continuous with the vertical or oblique portion, the vein bears a most important relation to the mastoid bone.

This portion of the vein, which on account of its course has been called the sigmoid sinus, runs along the posterior surface of the petrous bone near the posterior inferior angle, taking a course forward, downward and slightly inward. Near the apex of the bone it makes a turn inward into the jugular fossa, where it becomes continuous with the bulb of the jugular vein. Just before it enters the jugular fossa it becomes more narrow than elsewhere. The bulb is continuous downward with the internal jugular vein.

At the knee the sinus is joined by the superior petrosal sinus and in the middle of its course posteriorly it receives the emissary mastoid vein.

If we could, with any degree of certainty, count upon some regularity of the course of

the sigmoid sinus, the danger of its injury during mastoid surgery would not be so great, but we find marked variations in its course, its size and its relation to the surface of the bone, depending upon the age of the subject and the conformation of the bone and the side involved.

In some bones the groove in which the sinus runs is shallow, while in others it is quite deep and forms a well defined furrow.

Although a large sulcus is always indicative of having carried a large sinus, a small sulcus does not necessarily mean that the sinus was proportionately small, as the sinus, even though large, may hardly mark the bone on account of its situation further away from the bone between the layers of the dura.

Katz has pointed out that in those bones marked by a deep sulcus the groove is most pronounced in three distinct places. At the beginning of the sigmoid sinus, just below the knee it is at times quite deep, so that it extends to the cortex of the mastoid bone. In extreme cases it has been found to extend so far forward as to come immediately up to the posterior wall of the antrum, the latter being separated from it by a very thin, translucent sheath of bone, or it may form the posterior inferior wall of the antrum itself without any intervening bone. In the middle of its course the sigmoid sinus frequently encroaches upon the middle of the mastoid bone and occasionally reaches the cortex just behind the external auditory canal below the antrum.

The lowest of the three usual displacements is frequently found encroaching upon the occipital bone. The entire mastoid may be encroached upon by the sinus, leaving only a shell of bone surrounding it.

Zuckerkandle, Hartmann and others report dehiscences along the course of the sulcus of the sigmoid sinus, some of them of considerable size. They have been found at every part of the course of the vein, more especially towards the posterior wall of the ear canal, the tympanic cavity and reaches the pericranium. The

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average diameter of the lateral sinus is from 8 to 10 mm.

Just before it enters the jugular fossa it is subject to considerable variation in size and course. In some cases it turns downward without making an elbow, practically merging into the jugular vein. In such cases the jugular fossa is very shallow and the bulb not well defined. In other specimens it bends sharply around a well-defined bony ridge at the edge of the jugular foramen. In such cases the bulb is large and reaches a higher level.

Although the sinus is usually somewhat smaller just before it enters the jugular fossa than it is in the rest of its course, it is not uncommon for it to become quite a good deal smaller at this point. At times it has been found so narrow that the overhanging posterior inferior edge of the petrous bone almost closed it in as a canal.

From the measurements of series of skulls by different observers the fact has been established that in most cases the right sinus is larger and displaced more forward than the left. The cause of this inequality in size has been explained in that the right lateral sinus is a prolongation of the superior longitudinal sinus, while the left one springs from a smaller vein, the straight sinus. In some skulls the right and the left sinus are alike in size and in only a small percentage the left one is larger and runs more forward than the right.

The relations of the sinus during childhood differ considerably from those in adults. Cheate (Hunterian Lectures, page 69) says that in infancy the sinus lies in a horizontal position below and behind the antrum and is separated from it by dense cancellous bone. The sinus does not form the sharp turn at the knee, but runs more directly towards the jugular foramen which it enters without making the angular turn frequently seen later in life, hence it is not only relatively but also actually shorter than in adult life.

As growth takes place the sigmoid portion of the sinus adopts a more upright course and

becomes more tortuous, coming in close relationship with the posterior wall of the antrum and the upper part of the mastoid process, and making a sharper turn to get through the jugular foramen. The tortuosity seems to increase with age, perhaps on account of the venous pressure against the bone, so that in very old individuals we sometimes observe quite a deep sulcus. (Case 6.)

According to Braislin (Laryngoscope, 1911) the jugular fossae are shallow and nearly always alike in the new-born, but they increase in depth, and after the fifth year the inequality in depth and size of the right and left fossae is observed just as it is in adult skulls.

On account of the more frequent forward course of the sinus on the right side and the more highly developed bulb with the consequent existence of dehiscences, Korner believes that ear disease on the right side is more dangerous than on the left.

Politzer has found that in the large pneumatic mastoids, the distance between the sinus and the posterior meatal wall is greater, and the danger of injury of the sinus during operation correspondingly less than in the cancellous or compact bone.

According to Wanner (Katz Handbuck der Specillen Chirurgie des Ohres, etc.) the upper part of the lateral sinus is most apt to be injured in old cases of middle ear suppuration with sclerosed bone and the middle portion in the acute cases of mastoid disease with marked cancellous or pneumatic tip.

With such a variance in the course of the sinus there is a question as to what should be regarded as its normal course. Many measurements have been made to determine the average distance between the sigmoid sinus and the posterior wall of the meatus, the measurements varying from 5 to 19 mm. (Hartman). Amberg (N. Y. Med. Journal, September, 1905) has suggested the supra-meatal spine as a point of measurement, and as a rough estimate places the dividing line between the normal and the protruding sinus 10.6 mm. behind the spine.

The frequency of the forward sinus has been variously placed with an average of from 6 to 7 per cent of cases.

The bulb of the jugular and the fossa retaining it are also subject to great variation in size and shape. While in some specimens the fossa is so shallow that it is hardly recognizable in others it is well defined. In some specimens it has been known to extend so high upward that the sinus encroached upon the tympanic cavity through a dehiscence in the bony floor of the cavity. It has also been found to encroach posteriorly upon the petrous bone, and internally upon the condyloid process of the occipital bone, leaving only a thin plate of bone between it and the spinal canal. The anomalous position of greatest importance to the mastoid operator is its displacement backward towards the sigmoid sinus. Whenever this displacement is pronounced, the bulb may be very close to the middle portion of the sigmoid sinus if this is protruding.

To illustrate our subject I have secured ten skulls from the surgical laboratory of the University of Louisville. In six of this number the sinus groove on the right side is larger and situated more forward than the one on the left.

In one specimen (No. 6) the skull of a gray-haired man, the sinus in its first part made a most pronounced groove in the base of the petrous bone.

In three of the others there was only a slight difference in favor of the right, while in only one the left groove was larger and more forward and the jugular foramen and fossa larger than those of the opposite side.

It was a noteworthy fact that in all of the specimens with large forward sinuses the jugular foramen was large, and in most of them the bone was marked by a well developed prominence just at the edge of the foramen. In such cases the fossa for the jugular bulb was very large and extended high into the bone. On the side of the small sulcus (usually the left side) the foramen was uniformly

small and in several specimens extremely small, while the jugular fossa was very shallow.

While ten specimens cannot in any way be taken as conclusive evidence of the difference in the size of the right and left sinus, it verifies the result of many other observations. It seems to have been conclusively proven by the study of many skulls that the right sinus is larger than the left in a large majority of specimens, and that the reverse of conditions is rather to be looked on as an exception. So also the large jugular foramen and the large deep bulb on the right side compared to the left is the rule, and the reversal of conditions the exception.

My recent clinical experience would also lead me to believe that the forward sinus is more common than is generally believed. It would seem as a rather peculiar series of cases to find the sinus quite close to the mastoid antrum or to the ear canal eleven times in my last fifty cases, including acute and chronic forms. In nine of this number the vein was displaced forward in the first part of its course, and in two (Cases 9 and 10) in the second part.

I will ask your indulgence while I make a synopsis report of these cases with reference only to features bearing on the title of our discussion.

Case 1—Boy 8 years old. Acute mastoid abscess, left side, following two weeks of acute middle ear suppuration. Pus exuded as though under pressure at the first blow of the chisel over Macewen's triangle. A large cavity was found filled with pus and granulation. It included the antrum and extended backwards to the bare sinus, of which about one-half inch was bare. Below antrum the sinus extended forward almost to the ear canal.

Case 2—Boy 8 years old. Acute mastoid abscess, right side, following four weeks of acute otitis. Sub-periosteal collection of pus. Fistula over Macewen's triangle leading to an antrum about one-fourth inch in size. The antrum had firm, bony walls, except posteriorly, where a very thin layer (one-sixteenth inch) of soft bone had separated the antrum from the sinus. Removal of all of the softened area exposed about one-fourth inch of normal sinus.

Case 3—Boy 17 years old. Acute mastoid ab-

cess, right side, following acute middle ear suppuration of six weeks' duration. Elevation of the periosteum over the mastoid disclosed a fistula just behind the ear canal on a level with its superior wall. This led to a cavity one-half by three-fourths inch filled with pus and granulations. The cavity itself was lined with healthy firm bone, with the exception of the posterior wall, which had a dehiscence through which the healthy sinus was visible.

Case 4—Boy of 17 years. Mastoid abscess of the right bone following acute otitis with pus discharge of four weeks' duration. Operation revealed a rather large and superficial antrum filled with pus. Part of the floor and posterior wall of antrum was apparently formed by uncovered sinus, as this was readily exposed by cleansing the antrum without removal of bone backward.

Case 5—Farmer 19 years old. Acute mastoid abscess on the left side following otorrhoea of two weeks' duration. Operation revealed adherent periosteum over MacEwen's triangle. Its removal with curette lifted a thin spicula of bone and liberated pus from the antrum. The large antrum filled with creamy pus was marked posteriorly by a necrotic area, whose careful removal with a curette exposed three-fourths inch of sinus.

Case 6—Grocery clerk, 20 years old. Acute middle ear abscess, left side, mastoid abscess two weeks after beginning of otorrhoea. Considerable sub-periosteal pus over region of mastoid, fistula in bone leading to large antrum filled with pus. The antrum, posteriorly and upward, had healthy sinus for its floor over an area of over one-fourth inch.

Case 7—Young lady 20 years old. Acute otorrhoea, right side, of six weeks' standing followed by mastoid abscess.

Rather superficial large antrum filled with pus and granulation tissue. Below the antrum necrotic bone was removed backward to sinus. In following this upward it was found that the sinus was separated from the antrum by a mere crust of soft bone.

Case 8—Married woman 22 years old. In advanced stage of pulmonary tuberculosis and who had been operated on for acute mastoid abscess on the left side a year previously without exposing the sinus, although almost the entire tip of the mastoid was removed and a large antrum cleaned out.

The abscess of the right mastoid followed an otorrhoea of over three weeks' standing. Upon lifting the periosteum a large area of porous necrotic bone was exposed over the tip of the mastoid. A large area of necrotic bone was removed,

including the entire tip of the bone and extending close to the ear canal.

But a short way backward at this point the necrotic bone and granulation were in contact with the lateral sinus. Towards the tip the sinus extended backward. The antrum which was subsequently opened was very small and contained a quantity of stringy pus.

Case 9—Trained nurse 26 years old. Had been operated upon two years previously for a mastoid abscess on the right side without exposure of the sinus, although considerable of the mastoid bone was removed.

The left mastoid developed an abscess two weeks after beginning of otitis. The antrum, which was very deep, was free of pus. The tip contained a large pus cavity. Projecting into this cavity posteriorly an elevation of apparently normal bone. In removing spicula of bone from the highest portion of this projection quite a gush of blood from an opening in the bone revealed a forward sinus in the second part of its course.

As the operation was about completed when this accident occurred, the wound was plugged and the case dressed.

Case 10—Married woman 40 years old. Mastoid abscess, left side, after two weeks of acute middle ear suppuration. Anatomical conditions identical with the preceding case.

In removing a necrotic tip, the sinus was uncovered, bulging far forward into the tip, considerably below the level of the antrum.

Case 11—Colored woman. Otorrhoea, left side, six weeks, followed by an acute abscess of the left mastoid bone.

Operation revealed a very large antrum about one-fourth inch from the surface having a small area of sinus posteriorly for its floor.

Although these cases are not offered as conclusive evidence of the frequency of displaced sinuses, they serve to reimpress the uncertainty of the course of the vein. Among the quoted fifty operations there were quite a number in which the sinus was somewhat forward and in which the vein was exposed during the operation, but in the eleven reported cases the displacement forward was quite pronounced. Strangely the anomaly was observed more often on the left than on the right side (six times on the left and five times on the right), notwithstanding that of the fifty cases, twenty-eight involved the right side.

With the undisputed irregularity in the

course of the sinus and the consequent danger of injuring the vein during a mastoid operation confronting us, the question naturally presents itself whether the danger of injuring the vein during operation could in any way be diminished.

It has been proven conclusively that external measurements are uncertain in determining the position of the sinus and hence are of no practical value.

It seems that the only aid we have in determining the site of the vein is the study of the conformation and make-up of the mastoid bone. The assertion of Politzer that the strongly developed mastoid filled with pneumatic spaces is less apt to be injured than the diploëic or compact bone, has been borne out by most operators. It has been pointed out by Politzer that the prominent wide bone is usually of the pneumatic variety and the flat variety of the compact or diploëic, yet there are exceptions to this, so that the shape of the bone externally can only be looked upon as a suggestion of where the vein is situated.

Beck, Iglauer and others have made use of the X-ray in determining the nature of the bone texture and based upon the knowledge that the vein is farther away from the antrum in the pneumatic bone, have been able to conclude with some degree of certainty the site of the vein.

However, owing to the masked anatomical relations on the affected side through the presence of pus in the bone, the method has a practical application only in an indirect way by revealing the nature of the bone on the unaffected side and necessitating the assumption that similar conditions exist on the diseased side.

Mosher's transillumination serves a similar purpose as the X-ray, but has the same objection of having to be employed on the unaffected side and assuming like relations on the diseased side. It would seem that none of these methods offer the operator much aid in the performance of the mastoid operation.

In the absence of practical guides to the location of the sinus the surgeon must ever bear in mind that the vein bears an important relation to the mastoid bone, and that it is subject to great variation in its course. The bone should ever be opened cautiously by following closely the posterior wall of the ear canal and removing bony spiculae and necrotic areas carefully.

DISCUSSION.

Homer Dupuy, New Orleans.—This is a splendid contribution. Relative to the proximity of the lateral sinus to the antrum when the sinus is situated so close to this cavity that it actually forms a part of the antrum, I cannot recall seeing a case in which this variation in the course of the sinus presented itself. In regard to the dehiscences, the practical point in the differentiation between a dehiscence due to some anatomical variation and one the result of pathological changes, if a sinus is exposed the whole length of its course in the mastoid process, there being concomitant pathological changes in the mastoid, I would regard this exposure as the result of the morbid process. My observations allow me to draw the following conclusions with regard to the position of the sinus: A superficial sinus is usually one situated close to the meatus; a sinus close to the meatus usually means a highly situated antrum. No structure of the mastoid is so variable in its course and position as the lateral sinus.

Horace T. Aynsworth, Waco, Tex.—I think in reporting anomalies of the mastoid there are some very valuable lessons to be learned. I think in a practical application we learn from Dr. Pfingst's paper that in these cases we can expose the lateral sinus and the adjacent dura with impunity in our operations. It also teaches us we have to be expecting these conditions. In my own practice and teaching I think I have seen all these conditions. I feel justified in exposing the lateral sinus. One winter over half our cases were complicated with perisinus abscess. They were more in the middle portion, with a fair amount of space in between. I do not think there is any danger in exposing the dura in these cases. I think we should not hesitate to sacrifice the posterior wall even in the simple mastoid. In my opinion, there can be no harm in removing the posterior wall; in that way you keep well forward of the lateral sinus at all times.

There is another point; that is, as to the external shape of the mastoid process. Very often we can indicate by superficial examination of the mastoid the position of the lateral sinus. I have tried to figure it out in the dissecting room. The shape in a great many cases is fairly accurately indicated by a prominent ridge running along the course of the mastoid in the position the doctor indicated in his blue prints. The fact remains, if a man is a careful operator and uses his probe, there is little danger of injuring the sinus.

W. Likely Simpson, Memphis, Tenn.—I enjoyed

the paper very much. It brings out some very important points and is certainly very instructive.

About the relation of the sinus to the antrum, I would like to say a few words. I have had a radical operation just lately in which the sinus was so far forward and upward that there was practically no antrum present. It was a chronic suppuration so that it had to be operated.

I would like to mention another case in which, as the periosteum was removed from the mastoid, the blue tinge of the sinus could be definitely made out through the normal bone. After the bone was removed, the above statement was verified. It was in a patient about 40 years old. I think one should always operate so that one could not possibly cut the lateral sinus. We all know that we should not point a chisel so that it could cut the lateral sinus even though it uncovered it. One should use the same care also with curettes right along this line. It seems to me the relation of the lateral sinus to the antrum is very interesting, especially when the lateral sinus is far forward and high up. When one has to do the labyrinth operation, this condition is one of the greatest difficulties. At times in doing the labyrinth operation, the lateral sinus has to be uncovered and held back with a spatula so the labyrinth operation can be finished.

Another little point: In very many of these lateral sinus thromboses and ligation of the vein there is a choked disc present, which is probably an obstruction. This is present in a large majority of the cases in which the jugular is tied or where there is a lateral sinus thrombosis.

A. S. Bird—I think the section is indebted to Dr. Pfingst for this paper and this demonstration. The most important point to me is that it impresses the necessity of working on each case for itself and not by any general rule. That has been my plan in working. In Chicago I had the pleasure of seeing a good man operate. He removed the entire mastoid before he opened the antrum.

J. I. Dowling, Albany, N. Y.—The general surgeon is very apt to do it along that line. I have not seen the special surgeon do it that way.

Adolph Pfingst, Louisville, Ky. (closing)—I did not wish to create the impression that the sinus lies against the antrum frequently as it did in these cases, for I realize that I had a peculiar run of such cases.

These cases reported were taken from fifty mastoid operations seen in the last three years, and, as you have seen, the sinus was bare and against the antrum four times and separated from it by a small layer of necrotic bone in five cases. The two cases with the vein forward in the second part of its course presented nothing unusual.

The point made by Dr. Aynesworth regarding the conformation of the mastoid process externally in determining the location of the sigmoid sinus is of some value, for we know that in the large, high mastoid the sinus is usually far back, and in the low, flat bones that it is close to the sinus and ear canal.

There is one other point; that is, that the sinus sometimes comes over the antrum; that is, between the antrum and the cortex. In such cases the operator, in approaching the sinus through Macewen's triangle, would strike the sinus before

reaching the antrum. I have never seen a case with such anatomical conditions.

I thank you for the attention and for the discussion.

RUPTURE OF THE UTERUS.*

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Rupture of the uterus may occur prior to the normal termination of pregnancy or during labor. This brief paper concerns itself only with rupture during labor.

Statistics compiled from many sources indicate a marked variation in the incidence of this most tragic complication in different locations. The New York Lying-in Hospital, with a total of more than sixty thousand cases of labor, had up to 1909, the date last published statistics, forty-six cases of complete rupture, with a maternal mortality of 74 per cent, and foetal mortality of 83 per cent. Or an average of one case to thirteen hundred labors. The Glasgow Maternity in more than ten thousand labors averaged one to each 783 cases of labor. The same maternity reports two cases out of more than forty thousand out patients. Total cases for more than fifty thousand of out and indoor patients combined give an average of one to each 3,420 labors.

Jardine says it occurs once in each four thousand cases labor. Other authorities vary in their estimate from one to one thousand to one to five thousand. The thirty physicians in my city have had approximately eight thousand cases of labor. One of them, Dr. Donald, saw a case in his practice a number of years ago that resulted fatally. The average, therefore, for our immediate locality, has been one case to eight thousand labors.

TYPES: 1. INCOMPLETE. 2. COMPLETE.

The former, though reported less frequently, in all probability occurs many times without recognition, and affords an explanation

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