is made along the upper edge of the head and the socket, and into this a flat bone graft is driven (Fig. 6). In the latter procedure, a part of the great trochanter is removed and fastened on to a raw surface of the upper margin of the acetabulum and femoral neck. It has the two great advantages of being practically an

FIG. 6

FIG. 6.—Arthrodesis, by driving a wedge-shaped bone graft into the joint space above.

extra-articular procedure and of being much less shock-producing than any of the classical types of intra-articular arthrodesis (Fig. 7).

Excision of Femoral Head: Osteotomy

There still remain for consideration two other operative procedures, each of which has its definite place in treatment. These are, excision of the femoral head or a simple osteotomy.

Excision of the head of the femur removes the chief site of pain and disease, and it leaves a mobile hip, but

FIG. 7

FIG. 8

FIG. 7.—Extra-articular arthrodesis. The great trochanter is used as a graft applied to the upper surface of the socket and neck of the femur.

FIG. 8.—Osteotomy. This corrects the adduction, and the weight of the body is taken by the shaft of the femur rather than by the head.

these advantages are paid for by weakness and instability, while it is impossible to promise a freedom from pain. It should therefore be reserved for severe cases of arthritis affecting both hips, the more painful side being operated upon. The patient should be warned that he will probably be dependent on crutches for walking.

Lastly, there is the operation of subtrochanteric or intertrochanteric osteotomy (Fig. 8). The indication for this may not seem obvious at first sight, but I am convinced they are very real in special cases—that is, in cases where slow deformation of the head and neck of the femur have gone on to such a degree that a varoid deformity with the usual adduction of the thigh and raising of the pelvis

has taken place. These are usually unilateral cases and there is apparently great shortening of the leg.

Much more is gained by this osteotomy than the mere correction of deformity and lengthening of the leg. The weight of the body is thrown more directly on to the line of the shaft of the femur instead of being transmitted altogether through the diseased head and neck. Also the thrust of the femur will be against the apex of the acetabulum and not all against its upper margin, whilst this thrust will also be shared by the shaft of the bone projecting against the lower margin of the sockets.

CONCLUSION AND SUMMARY

One fears that the recital of so many alternative methods of operative treatment will lead to the impression that none of them are very satisfactory. To some extent this is the case. Osteo-arthritis of the hip is essentially a process of wear and tear, resulting from two main factors—age and trauma—to which some toxic factor may be added in a minor degree.

Treatment must usually therefore be only palliative and not radical or curative. But on the other hand the relief of pain is a great achievement, and I say with considerable conviction that patients with hip osteo-arthritis treated by a well-chosen operation are nearly always very grateful and satisfied with the measure of relief afforded them.

The following summary of the indication for these various operative procedures may be made:

1. Marked osteophytic outgrowths, resulting from trauma and confined to one hip—*cheilotomy*.
2. Hip in which socket is deep, head and neck enlarged so that the joint has become "seized"—modified *arthroplasty*, either lessening the head or removing part of the socket.
3. Painful hip—*arthrodesis*.
4. Double arthritis with stiffness of both hips and much pain—*excision* on the worst side.
5. Cases with varoid deformity or subluxation—*osteotomy*.

SINUSITIS AND ITS RADIOLOGICAL DEMONSTRATION*

BY

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(With Special Plate)

Although the great utility and accuracy of radiology as a diagnostic aid in many pathological conditions has been universally recognized, its accuracy and possibilities when properly applied as a method of diagnosis in diseases of the accessory nasal sinuses have not been appreciated to anything approaching the proper extent. In laryngological textbooks scant heed is paid to the subject, and laryngologists—though not without reason—are disinclined to place much reliance on *x-ray* findings, and still less so if these findings conflict with their own clinical diagnoses. Yet hyperplastic changes, or fluid, in air-containing cavities in other parts of the body are constantly being demonstrated with extreme accuracy. The *x-ray* findings can be as accurate, if not more accurate, in the accessory nasal sinuses provided that the simple anatomical and physical facts of the problem are borne in mind. What are these facts?

GENERAL CONSIDERATIONS

When one *x-rays* the skull one is *x-raying* the most complicated bony structure in the body, throwing multiple shadows, widely differing in distance, size, and density,

* Paper read in the Section of Oto-Laryngology at the Centenary Meeting of the British Medical Association, London, 1932.

on to the single plane of the x -ray film. A small difference in the angle of incidence of the rays, in the point on the skull over which they are centred, or in the positioning of the patient's skull, will swing the shadows of structures a few inches away from the film through a wide arc and cause a big variation in their relative positions to structures closer to the film. Hence the absolute necessity for taking the radiograms at constant and standardized angles for every patient's skull, irrespective of individual differences in shape, for exact centring and angulation of the tube, and for taking several views from different standardized angles. In the majority of textbooks dealing with the subject one finds only three views mentioned—a lateral view, and two other views described respectively as the "nose-chin" and "nose-forehead" positions. These are not, in fact, "positions" at all, and the multiple shadows in the resulting radiograms depend for their situations relative to one another on nothing more accurate or scientific than the widely varying facial contours of individual patients. It is hopeless to expect accurate x -ray findings from such inaccurately taken x -ray films.

For example, Figs. 1 and 2 (see Plate) are two radiograms, both of the same patient. Fig. 1 was taken in the "nose-chin" position, and it will be seen that the lower parts of both antra are concealed by the shadows of the petrous bones, this being brought about by the patient having a long chin and a short nose. In this radiogram nothing abnormal can be detected. Yet Fig. 2, taken a few minutes later at the correct angle, throws the petrous bones clear of the antra and shows the right antrum to be half filled with pus.

This is only one illustration of the impossibility of demonstrating radiologically pathological conditions in the accessory nasal sinuses with any degree of accuracy by haphazard radiographic technique. Given correct radiographic technique the x -ray findings in the accessory nasal sinuses are as uniformly accurate as in any other part of the body—if not more so. My first point, therefore, is that one cannot over-emphasize the absolute necessity for accurate and standardized technique in the radiology of the accessory nasal sinuses.

Importance of Erect Posture

When x -ray apparatus gave only a small output, and before the days of duplitized films and intensifying screens, the exposures were very long, and the only position in which the patient could keep reasonably still was either the prone or the supine. In spite of the vast improvements in power and speed that have reduced the exposures to, at the most, a matter of six or eight seconds, by far the greater majority of x -ray examinations—with the exception of the chest—are carried out in the recumbent position. In the majority of instances there is no disadvantage in such a position, but it is definitely contraindicated when the part to be x -rayed is an air-containing cavity which may be abnormally opaque to x rays as a result of pathological changes in the mucosa or of pus. If one wishes to examine the contents of a glass jar, and to ascertain whether its content is solid or fluid, one does not look at it from above or below, as that would not give one the required information. One naturally holds it on a level with one's eyes, so that the light passes horizontally through the material to one's eye. In this position one can examine the structure of the material, see the upper border, and ascertain whether it is fluid or not by tilting the jar from side to side. If it is fluid, this upper border will remain horizontal whatever the position of the bottle. The same thing applies to the sinuses if they are x -rayed in the upright position. If they are x -rayed in the prone position gross pathological changes may easily escape detection.

Fig. 3, for instance, shows nothing much wrong beyond a slight degree of cloudiness in the antra. But the radiogram

was taken in the prone position. Fig. 4 is a radiogram of the same patient, but taken in the erect posture a few minutes later, which shows a collection of pus in both antra. What happens is that in the prone position the fluid is spread out in a thin film over the antral wall, and when the amount is small it is insufficient to cast an appreciable shadow. In the erect position, however, the fluid is all collected into a pool in the lower part of the sinus, and is at once obvious.

Normal Transradiancy

Another possible source of error is the widely held assumption that the radiological detection of sinus infection depends on the observation that one sinus is more opaque than its fellow of the opposite side. One has only to consider the matter for a moment to appreciate how misleading radiological evidence based on this fallacy might often be. For, on the one hand, a sinus may be small and poorly developed with thick bony walls and consequent small air content, which, though non-pathological, is opaque when compared with the opposite normally developed sinus. On the other hand, a pair of sinuses may often contain an equal amount of pus or thickened lining membrane, and since both will allow an equal amount of rays to pass, they would both, on this assumption, be considered radiologically normal. The only safe and reasonable basis for radiological diagnosis is the radiologist's acquaintance with the normal degree of transradiancy which each sinus should give, according to its size and air content. This necessitates a thorough knowledge of the standard normal, and obviously can only be gained by taking the radiograms in standard positions.

STANDARD TECHNIQUE

It will be as well here to describe the six standard views which I use. They are all taken in the erect position, and at definite and accurately measured angles for every patient, irrespective of any difference in facial contour. For this purpose I designed the special "sinus stand" illustrated in Fig. 5. In each case I take six views as follows:

1. *Occipito-frontal View.*—The head is grasped by the head-clamp in the bi-temporal diameter and the head-clamp is adjusted so that the antero-posterior diameter of the skull

Diagram showing relations of sinuses illustrated in Fig. 6 (Special Plate).

is perpendicular to the film, the angle being read off on the dial. An imaginary line is taken joining the external auditory meatus and outer canthus of the eye, which for brevity I call the "orbito-meatal line." This line is so adjusted by means of a protractor that it is perpendicular to the film; the tube is centred half an inch below the external occipital protuberance and the exposure made. A typical result is shown in Fig. 6. The petrous bones will be seen to be thrown well above the antra in this position. The principal use of this view, however, is not to show the antra, but to show whether there is any abnormal opacity of the ethmoidal labyrinth or of the sphenoidal sinuses. On either side of the perpendicular plate of the ethmoid two air spaces are seen. These air spaces in this position consist of the superimposed shadows of the anterior and posterior ethmoidal cells and the sphenoidal sinuses from before backwards, and normally they are clear.

2. *Occipital-mental View*.—In this view, the head, still grasped in the bi-temporal diameter, is so adjusted that the orbito-meatal line subtends an angle of 45 degrees to the film, this angle being open towards the feet. The resulting radiogram is shown in Fig. 7. In this position the petrous bones are seen to be thrown clear below the antra, thereby giving an unmolested view of these sinuses. The anterior ethmoidal cells are thrown clear of the posterior group of sinuses, and the frontal sinuses are well shown.

3. *Vertico-mental View*.—In this position the patient extends the head as far back as possible on the neck. There can obviously be no standard angle through which all patients can extend the head, but this is compensated for by so tilting the tube that, whatever this angle may be, the central ray is constantly vertical to the patient's vertex. Fig. 8 gives a good view of the sphenoidal sinuses.

4. *Right Oblique View*.—The head, still grasped in the clamp, is rotated through an angle of 39 degrees, the occiput moving towards the right. The chin is then depressed until the orbito-meatal line is at 35 degrees, the tube being centred just behind the left mastoid process. This view throws the shadows of the right posterior ethmoidal cells, and incidentally the right optic foramen, into the shadow of the right orbit.

5. *Left Oblique View*.—This is the same as the right oblique view, but in this instance the occiput is rotated through 39 degrees to the left, thereby showing the left posterior ethmoidal cells (Fig. 9).

6. *Lateral View*.—This is an ordinary lateral view of the sella turcica and accessory nasal sinuses, and is useful in cases of congenital absence of one or both frontal sinuses, and in cases in which one or other antrum is poorly developed, with thick bony walls, and is consequently more or less opaque in the anterior view. The lateral view throws into relief the thick bony walls, and consequently clears up the cause of the opacity.

These, then, are the six standard views used in this technique. It will be seen that they are all necessary, since they are ancillary to one another and each forms a composite part of the whole. It will also be seen that, by using this technique, a radiogram taken in any given one of these positions will correspond exactly, so far as the normal shadows are concerned, with the radiograms taken of any other patients in the same position. Thus, by this method any variation from the normal will be at once apparent to the experienced radiologist. Necessarily, it takes a little time and experience to distinguish accurately each of the multiple normal shadows in each view, even when they are invariably projected into the same relative positions by the technique which I have described. One can imagine how unnecessarily difficult this becomes when they are thrown all over the film according to the prominence of the patient's nose, chin, or forehead, and how next to impossible it is—under such conditions—to recognize pathological changes with any approach to accuracy.

RESULTS OBTAINED

It is entirely due to a haphazard technique that otolaryngologists as a whole have hitherto placed little reliance on x -ray findings. It is my aim to show that radiology properly employed can give information regarding the condition of the sinuses which is not exceeded—and I doubt if it is equalled—by any other method of investigation as a preliminary to possible operation.

At King's College Hospital, and in my private practice, we have very carefully checked with our laryngological colleagues the proof puncture and operation findings in a consecutive series of 250 cases. In every one of these cases the x -ray findings were proved to be correct. When a fluid level was shown in the radiograms, immediate proof puncture was carried out. For a test like this such an immediate procedure was obviously necessary, as otherwise the pus might drain out in the interval. Such a

trial of method necessarily entailed between our laryngological colleagues and ourselves a very close co-operation, which is impracticable in ordinary routine work. But although, since that test group of cases, between three and four thousand examinations of the accessory nasal sinuses have been carried out, and we have frequently inquired as to the accuracy of the diagnoses, in not one instance have we heard or been informed of an error in the x -ray findings. On several occasions where the x -ray findings showed, on the one hand, thickened lining membrane but no fluid, or, on the other hand, a fluid content, proof puncture—but carried out several days later—showed the contrary. But in each of these cases the x -ray evidence of one or other condition was so definite that it was obvious, not only to ourselves but to the laryngologist himself, that the discrepancy was due to the filling or the emptying of the sinus in the interval between x -ray examination and the proof puncture. I think it is highly probable that where there is gross thickening of the lining membrane in the ethmoidal cells pus in one or more of the cells might be concealed by the general opacity of the superimposed cells. Also, in cases where there is marked hyperplasia of the mucosa, the outlines of, say, an antral polypus might easily be concealed by the general thickening of the mucosa. But taking the method as a whole, I have no doubt that you will find that radiology, properly applied, can be of the very greatest use to you. The method, as you see, is quite simple and straightforward, and, given the necessary apparatus and experience, any radiologist can carry it out.

ILLUSTRATIVE CASES

Further figures in the Special Plate illustrate the use and principles of this method in regard to sinusitis and other conditions.

It will be recalled that in Fig. 6, showing the occipito-frontal view, two air spaces are seen on either side of the perpendicular plate of the ethmoid. They consist (see diagram in text) of the superimposed shadows of the anterior and posterior ethmoidal cells and the sphenoidal sinuses from before backwards. Fig. 10 shows the space to the right to be opaque. Further radiograms having demonstrated that the anterior and posterior ethmoidal cells are clear, the vertico-mental view (Fig. 11) shows the opacity of the right space to be due to an infected sphenoidal sinus. It will be seen, therefore, that, starting with the occipito-frontal view, one has a double check on the condition of the ethmoidal labyrinth and the sphenoidal sinuses, which works out something like a game of patience. Occasionally, where there is unilateral deficient development of these sinuses, their comparatively thick bony walls will make the air space on that side opaque, although no pathological lesion is present. The other views, however, will show the reason for this opacity, while it must be borne in mind that if the angle is not exact the shadows of other structures will be thrown into the air spaces.

Fig. 12 illustrates another point. The horizontal line in the left antrum suggests that it is half full of fluid. That is an *assumption*, based on the horizontal upper margin. When the head is tilted to the left (Fig. 13) it is seen that the upper margin remains horizontal. Tilting to the opposite side (not shown) has a similar result. Nothing but fluid will remain horizontal in a cavity when that cavity is tilted. Thus the shadow is due to fluid, a fact based on *proof*, which can leave no shadow of doubt as to its accuracy. Fig. 14 shows fluid in a frontal sinus, confirmed by the tilt, while in Fig. 15 fluid can be seen in the sphenoidal sinuses.

A sinus may be transradiant or opaque to x rays. Opacity may be due to a fluid content or to dis-

ease of the wall, or to both, and *these are the only three possibilities*. The evaluation of normal transradiancy is a matter of experience, based on the size of the sinus, its air content, and the definition and clarity of the bony walls or foramina projected into the shadow of the sinus. With experience this can be accurately determined. The extent to which incontrovertible proof can be given by x rays regarding a fluid content has already been shown. With regard to the third possibility; since two are proved the third is simple. If a normally developed sinus is opaque to x rays and no fluid is present, the opacity must be due to thickening of the mucosa; I am, of course, excluding such comparatively rare conditions as new growth, bone disease, or thickening of the superimposed soft tissues, which, though demonstrable as such, do not enter into the scope of this paper. But quite apart from this proof by elimination, I believe I can show that not only thickening of the lining membrane, but the *type* of thickening, is as accurately demonstrable as fluid. However gross the hyperplasia may be it does not conceal fluid, except possibly in the case of the ethmoidal cells. Fig. 16 shows marked hyperplasia of the mucosa in both antra. It should be noted that, whereas at the periphery the rays are traversing the entire longitudinal thickness of the thickened mucosa, in the centre they are traversing the two layers of mucosa on the posterior and anterior walls, and consequently one sees a central comparative transradiancy if the penetration be increased to the correct degree. You will notice the thickened mucosa in both antra, and at the same time a horizontal level in the left antrum. The skull is tilted (Fig. 17), and the thickened membrane tilts with it; but the horizontal line in the centre of the left antrum remains horizontal, and therefore this sinus, in addition to thickened lining membrane, contains fluid.

Fig. 18 shows a different type of case. One sees an opacity occupying the lower half of the left antrum with a convex upper border, but there is a small gap between the upper part of its inner border and the antral wall. On tilting (Fig. 19) the upper margin tends to remain horizontal, but does not quite succeed in doing so, and the gap between its inner margin and the antral wall becomes wider. It is therefore fluid, but encysted fluid, and the obvious deduction is a cystic polypus. The diagnosis in this case was proved correct at operation.

A solitary polypus in the left antrum is seen in Fig. 20. Fig. 21 also shows polypi in the left antrum. In this picture is also seen the dense hard line around the periphery of the sinus. This is due to fibrosis of the periosteal layer of the mucosa, and is the result of long-standing infection. In acute and subacute conditions one sees, instead of the dense basal layer, a hazy, "ground-glass" appearance of the mucosa (see Fig. 22), which varies in opacity according to the duration of infection. It is caused by oedema and swelling of the mucosa proper. A slight degree of this oedematous swelling is usually seen following antral "wash-outs." Fig. 23 shows a similar acute or subacute "ground-glass" type of opacity in the right sphenoidal sinus, while in Fig. 24 is seen the chronic fibrotic type of hyperplasia, also in a sphenoidal sinus.

CONCLUSION

I have endeavoured to demonstrate in this paper, on the one hand, the impossibility of accurate x -ray diagnosis in the accessory nasal sinuses with the radiograms taken at haphazard angles or in the prone position, and, on the other hand, how accurate is the information obtained when the radiograms are taken at carefully measured and standardized angles and in the erect position. The underlying principles of the method are, I think, logical and obvious, and to any experienced radiologist the technique will be simple. I am sure that there is a very wide field

of work to be carried out in co-operation between the laryngologist and the radiologist, and I have tried to indicate above a method of approaching that work. I hope that what I have said will be of use to both branches of the profession.

Before closing I should like to express my thanks to my laryngological colleagues at King's College Hospital and the Central London Throat, Nose and Ear Hospital, especially to Mr. Jenkins, Mr. Negus, Mr. Gill-Carey, and Mr. Cawthorne, for all their help and encouragement, and to my assistant, Mr. Crichtlow, for his untiring zeal and energy. And last, but by no means least, I wish to thank Messrs. Newton and Wright of London, who took the greatest pains and trouble in manufacturing my sinus stand.

[In Fig. 17 for "tilted to left" read "tilted to right."]

ADENOMA OF ISLETS OF LANGERHANS ASSOCIATED WITH HYPOGLYCAEMIA

BY

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(With Special Plate)

Adenomata of the islets of Langerhans are rare, and up to the present time no case with clinical manifestations has been reported in this country.* We desire to record the following case, in which such an adenoma was present, associated with periodic attacks of hypoglycaemia, and ultimately proving fatal.

REVIEW OF REPORTED CASES

Warren¹ in 1926 was able to find in the literature records of only fifteen adenomata, though he himself added four more from his own experience, suggesting that these tumours may be more common than is supposed. He pointed out that little attention is paid to the pancreas in routine post-mortem examinations, and that small adenomata may be easily overlooked. He was of the opinion, however, that they were of no clinical significance.

The association of a pancreatic tumour with hypoglycaemia was not established until, in 1927, Wilder, Allen, Power, and Robertson,² in America, studied and reported a case in which the condition was caused by a carcinoma originating in the islet tissue. The patient was a physician aged 40. When specially observed, in a little over three hours after a meal he complained of a sense of apprehension and depression, with vague paraesthesiae; the blood sugar was found to be 0.055 per cent. Fifteen minutes later perspiration and trembling were noticed. Four hours later twitching of the face and incoherence of speech occurred, the blood sugar being 0.036 per cent. After four and a quarter hours he became stuporous, unable to speak, and developed convulsions. At this stage the blood sugar had fallen to 0.027 per cent. Fifteen grams of glucose were then given by the mouth, and in ten minutes he was capable of rational conversation, the blood sugar having risen to 0.065 per cent. The patient eventually succumbed, and at necropsy, in addition to the primary growth, metastases were found in the liver and lymph glands. It is of interest to note that the cells bore a striking resemblance to the cells of the islets of Langerhans, and that alcoholic extracts from cancer tissue in the liver had an insulin-like action when injected

* Since writing this paper we have seen that in the current issue of the *Journal of Pathology and Bacteriology* (November, 1932) W. G. Barnard reports a fatal case in a woman aged 40.

H. K. GRAHAM HODGSON: SINUSITIS AND ITS RADIOLOGICAL DEMONSTRATION

FIG. 1.—Radiogram taken in so-called "nose-chin" position. Lower parts of both antra are concealed by superimposed shadows of petrous bones.

FIG. 2.—Same case as Fig. 1, but taken at correct angle in erect position. Shadows of petrous bones are thrown below antra. Right antrum is seen to be one-third full of pus.

FIG. 3.—Radiogram taken in prone position showing slight cloudiness of antra.

FIG. 4.—Same case as Fig. 3, but taken in erect position. Note fluid levels due to pus in both antra.

FIG. 9.—Left oblique view. A = Left optic foramen. B = Left posterior ethmoid cells.

FIG. 10.—Occipito-frontal view. Showing opaque air-space on right of perpendicular plate of ethmoid.

FIG. 11.—Vertico-mental view. Same case as Fig. 10, showing opaque air-space, seen in occipito-frontal view, to be due to an infected right sphenoidal sinus.

FIG. 12.—Taken in erect position, showing opacity with horizontal upper margin—therefore probably due to fluid.

FIG. 17.—Same case as Fig. 16, but with head tilted to left. Line in left antrum remains horizontal and is therefore due to fluid.

FIG. 18.—Cystic polypus in left antrum.

FIG. 19.—Same case as Fig. 18, but with head tilted to right. Upper margin of convex shadow does not abut accurately on antral wall and does not remain quite horizontal when head is tilted.

FIG. 20.—Solitary polypus in left antrum.

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FIG. 5.—Showing Graham Hodgson "sinus stand" with patient in position for occipito-mental view.

FIG. 6.—Occipito-frontal view. A = Superimposed shadows of anterior and posterior ethmoid cells and sphenoidal sinuses from before backwards. (See diagram in text.) B = Maxillary antra.

FIG. 7.—Occipito-mental view. A = Frontal sinuses. B = Anterior ethmoid cells. C = Maxillary antra.

FIG. 8.—Vertico-mental view. A = Sphenoidal sinuses.

FIG. 13.—Same case as Fig. 12, but head is tilted to left. Note that horizontal upper margin of opacity still remains horizontal. Nothing but fluid in an air-containing cavity can give this appearance.

FIG. 14.—Showing a horizontal fluid level in the right frontal sinus.

FIG. 15.—Showing a fluid level in both sphenoidal sinuses.

FIG. 16.—Chronic hyperplasia of mucosa in both antra, with horizontal line in left antrum.

FIG. 21.—Typical appearance of fibrosed lining membrane, shown as dense shadow around periphery of left antrum. Note also fainter rounded shadow of two polypi projecting into central portion of sinus—no fluid present.

FIG. 22.—Oedematous mucosa of left antrum.

FIG. 23.—Oedematous mucosa in right sphenoidal sinus due to an acute or sub-acute infection.

FIG. 24.—Chronic fibrosis of mucosa in left sphenoidal sinus.