THE X-RAY IN RHINOLOGY.

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Following the introduction in America in 1895 of Professor Roentgen's discovery of the X-Ray, physicians became immediately impressed with the marvelous possibilities of such a means of diagnosis in the practice of medicine and surgery. At once skiagraphy sprang into prominence, surgeons vying with one another to perfect its use. Its application in the special fields, however, lay untouched for some years until gradually it became the routine measure of dentists in dealing with certain affections of the teeth, upper jaw and ankylosis of the inferior maxilla. Occasional cases of the localization of foreign substances within the eyeball, trachea and oesophagus were soon reported.

As early as 1902-3 the use of the X-Ray in connection with the maxillary antrum in detecting offending toothroots and the X-Raying of metal catheters placed in position in the naso-frontal duct enjoyed rather extensive use. Kassabian¹ notes that "The first skiagraph of the teeth was presented to the society of physics of Frankfort-on-the-Main, in February, 1896, by Prof. Koenig. In April of the same year Woekhoff at the Congress of Erlangen demonstrated many skiagraphs of the teeth in the living subjects." A month later Morton² showed that the structure of the teeth can be studied and many interesting conditions of the antrum of Highmore as well. In 1903 Dr. Wm. S. Haughton of Dublin exhibited some excellent stereoscopical radiograms of dried skulls. A little later Killian and Hajek in Germany began the use of X-Ray plates in normal and pathological conditions of the accessory sinuses.

Among our earliest American papers on this subject are those of Cryer³ of Philadelphia and Coakley⁴ of New York. Caldwell⁵ of New York, an expert Roentgenologist who had been doing work with Coakley in this direction, already had a very fine collection of plates. His results were excellent, the difference between a diseased and a corresponding healthy sinus being marked. Phaler⁷

but a short time before had shown that cerebral skiagraphy was to have a place in cranial surgery and also remarked that the accessory sinuses could be photographed as well. Cryer received his impetus in this work while on a visit to Dublin, by seeing many of Haughton's plates. Coakley says that he first observed the use of the X-Ray in Killian's clinic at Freiburg. Mosher⁸ of Boston, following Coakley's lead, soon published a paper in February, 1906, on *The Use of the X-Ray in Sinus Diseases*, in which he carefully analyzed the plates of a number of cases. Chisholm,⁹ Jack,¹⁰ Harland-Pancoast,¹¹ Scheier, Spiess and others contributed further to this subject.

It can no longer be lamented that "If surgeons who treat this region had some way of determining the character of these sinuses in the patient, then treatment could be given on a more scientific basis," as the practice of X-Raying our patients before operation has become well-nigh universal. It is rather rare in surgery for the surgeon to have beforehand an almost exact knowledge of the size, situation and outline of the structure and many of the difficulties to be encountered in connection with the sinus which he wishes to attack.¹²

In a high percentage of cases the presence of pus can also be diagnosed. One of the chief reasons which early prevented specialists from doing more of this work had been the difficulties of properly interpreting plates. As expressed by Williams¹³ the fact that "The eye must be trained in the use of the X-Ray as is the ear for osculation or percussion" was not appreciated and advances were at first necessarily slow. Another point to be borne in mind, as in the case of all observations on which a diagnosis is made, the conditions revealed by the X-Ray plate are only to be properly understood after experience has enabled the doctor to give these observations their due weight.

As "the best opportunity for the advantageous application of the X-Ray is obtained from the contrast of the normal tissue with that offered by pathological conditions of the corresponding region involving chiefly an increase in density," it is essential that one become familiar with the appearance of the picture in health. If a plate does not show contrast from one direction it may in another. Often plates are not taken to establish the presence of a diseased area, but simply to ascertain the anatomical outline and position of a certain cavity within the bone. Therefore we can at once group plates into two classes. The first to ascertain the anatomy of the

part as in a lateral plate; second those for the purpose of contrasting corresponding sinus areas to show pus (antero-posterior plate). The latter will also give some of the anatomy.

Roentgenologists tell us that the difference in resistance which air and various pathological fluids formed within the sinus in disease offer to the passage of the rays can readily be formulated. To these is added in this special region a background of bone lines and shadows which in turn must be discounted. If physical signs give more information than an X-Ray examination, so much the better. It would be a mistake to claim that an X-Ray plate is infallible. It is unfortunate that we have no tables which give the percentage of plate failures in the detection of pus. Roughly, I should say that plates will demonstrate pus or infiltrated mucous membrane in perhaps seventy per cent of frontal suppurations, eighty-five per cent ethmoidal and thirty-eight per cent antral. Plates in sphenoidal trouble have as yet been more or less unproductive in finding pus. In dealing with X-Ray plates, one must be sure that the best possible picture has been obtained and the plate not "fogged." Poor plates had better be discarded.

With regard to the value of skiagraphy as an aid in the diagnosis and treatment of disease of the accessory sinuses of the nose Coakley early published the following conclusions:

1. It is possible by means of a skiagraph to determine the presence or absence of a frontal sinus which extends vertically above the glabella.

2. A frontal sinus may be small, parallel with the upper inner margin of the orbit and hardly detected in the skiagraph.

3. In all cases of unilateral diseases of the frontal sinus verified by operation, a cloudiness has been observed in part or all of the area occupied by the sinus and an indistinctness in the outline of the cavity when compared with the opposite or healthy side.

4. The examination of a skiagraph of the two frontal sinuses when compared with results found on transillumination will aid very much in determining the presence of a diseased sinus.

5. A skiagraph may also be of considerable value in determining the height and width of the ethmoidal cell area and the sphenoidal sinuses.

6. If the plate be so arranged as to include the superior maxilla as well, a chronic separated process in an antrum often presents the same filmy appearance as noted in similar conditions of the frontal sinus and ethmoid cells. A healthy antrum presents an

irregular triangular area dark in color with a few light colored septa running through it, many of which are ridges present in the wall.

Although to this much has since been added, results show most conclusively that the value of the X-Ray has not been overestimated. Cryer states, "It has demonstrated by all who have investigated the pneumatic sinuses intimately that they exist in an indefinite variety of sizes, shapes and positions, so that even clinical experience counts for little as no two cases present like conditions. It is evident that a good radiogram, if stereoscopic, so much the better, is one of the most reliable witnesses for the surgeon's dependence in diagnosing the character and disease of the frontal sinus region."

Dentists draw attention to the fact that cases of odontalgia frequently reported are undoubtedly due to an unerupted tooth, in which cases the etiologic factor may be revealed by the X-Rays. Also patients suffering intense neuralgia with painful reflexes from the ear, nose and eye have shown pericemental and alveolar necrosis. Foreign bodies, defective root fillings, fracture and the position of metal splints can all be studied by intra-oral or extra-oral methods. Antero-posterior plates have helped me considerably in dealing with orbital abscess of suspected nasal origin. Plates in brain conditions give but little information as yet. Aneurysm of the internal carotid artery within the cavernous sinus, the result of basal skull fracture, has not been shown. Plates in double optic neuritis of possible sphenoidal etiology have yielded little.

Having been the first to suggest securing the size and outline of the sphenoidal bone in further simplifying an operative measure through the nose for septic thrombosis of the cavernous sinus, I have endeavored to tabulate the bone lines and shadow areas in lateral plates, but without much success. According to Carothers¹⁰ "Stereoscopy as applied to skiagraphy is the most improved method and would seem to give the most accurate location of a foreign body, sinus, etc. The ordinary Roentgen ray plate looks flat. The stereoscope, however, gives a prospective view much as if the parts were before one."

THE LATERAL PLATE.

Two lateral plates are required, one for each side. A diagnosis of pus is not attempted from the lateral plate. This plate shows the presence or absence of the frontal sinus, its size and the extent

or position of supra-orbital cells. Any ethmoidal cell encroaching on the frontal from either below or behind will be shown. In a general way, also, the relationship between the frontal sinus and anterior ethmoid cells can be distinguished. Mosher has observed, "If the floor of one frontal sinus is higher than the floor of the other or overlapping, the line of the higher sinus will appear in the other sinus as a horizontal ridge and may be mistaken for septa." It is not safe to try to compare a right lateral with a left lateral plate, for the reason that the respective sides of the head are seldom alike. The malar bone gives a shadow obscuring a considerable number of the anterior ethmoid cells. In good plates the position of the posterior ethmoid cells can occasionally be made out. The outline of the body of the sphenoid with its cavity is prominent. Small polypi within a frontal sinus have been shown in a lateral plate. Lateral plates may occasionally also throw light on some obstinate case of headache, where the refractive error is corrected and there seemed no reason to treat the nose. It is easily seen that if the X-Ray is of importance in choosing the best external operation they are of even greater value to those surgeons who may select an intra-nasal route in an attempt to enlarge the naso-frontal duct by the use of a burr. The X-Ray plate has done much to make such a procedure safer than it has ever been before. The lateral plate may also be used in retro-pharyngeal growths and suspected abscesses. Roentgenologists are already obtaining fair pictures of oesophageal pouches. For the lines given by the floor of the anterior canal fossa the reader is referred to any of the articles on this subject. Lateral plates require usually more study than many are willing to give them. An excellent way to begin the interpretation of bone lines is by a good resume of anatomy, with a skull in one hand and a plate in the other.

THE ANTERO-POSTERIOR PLATE.

Often after a physical examination, to clinch the diagnosis of pus in the ethmoid cells or frontal sinus, we resort to the use of the X-Ray, taking the picture of the face. This is done with the plate in front of and against the face, the rays coming from behind. In regard to the detection of pus made from this plate, it is necessary to state that the difference between a diseased and a normal sinus is so slight that a positive diagnosis must be made very carefully. As has been said, in cases of unilateral disease of the frontals or ethmoid region a cloudiness is observed in the plate. In a normal

sinus, one gets a clear general outline of sinus wall and a relatively clearer space within. In a diseased sinus, filled with pus, the side affected is more opaque than the free side and sometimes practically obliterated. The result of this process of "matching up" is then applied to the case at hand. This plate, too, shows the size of the frontal sinus and the presence of septa and orbital prolongations. In acute inflammation of the sinus if pus has drained into the nose the infiltrated mucous membrane will give a shadow on the plate. Authors have suggested following the progress of acute inflammations and granulating sinuses by taking successive plates. Infiltrated mucous membrane does not always, however, give a shadow and especially is this true in the maxillary antrum:

In conclusion it may be stated that the use of the X-Ray has done as much for the advancement of surgical rhinology as almost any hitherto single discovery in the domain of medicine or surgery. Today we are hearing much about the opsonins and especially their use in chronic suppurations. Infection, immunity and serum therapy are subjects attracting the most profound attention. It may be that a combination of X-Ray in diagnosis and opsonic serum for treatment after a proper surgical incision will stand out as one of the advances of the first quarter of the century in dealing with certain affections of the nasal sinuses.

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