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PANTOMOGRAPHY OF THE BASE OF THE SKULL

by

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Pantomography signifies a roentgenographic method whereby it is possible to obtain images of both internal and external curved layers. If an ordinary roentgen film is used, the layer reproduced will appear straightened out into a plane. Such a picture represents, in fact, a panoramic view of the curved layer; and it is this feature which gives the method its name — a combination of the words panorama and tomography.

By means of pantomography it is theoretically possible to reproduce layers of any shape and at any depth, because the shape and position of the roentgen film determine what layer is accurately projected unto the film. I wrote about this as early as 1950⁴ and have followed up my first article with many more in subsequent years. Moreover, I have demonstrated in my lectures with schematic illustrations how it is possible to take roentgen pictures of, for instance, conical layers by bending the film into the shape of the layer in question and placing it on a rotating cassette table in a manner corresponding to the position of the layer. Likewise with the aid of pictures, I have pointed out how easy it would be to reproduce on films various curved layers as well, such as ball- or barrelshaped ones, provided correspondingly shaped films were produced. Pictures of this kind could not, of course, be straightened out but would have to be kept and looked at in their original shape, which naturally would involve certain disadvantages.

The aforementioned possibilities, which are nearly unlimited in respect to the shape and position of the layer to be radiographed, stem from the use of the rotating cassette table. After experimenting at first with a straight cassette that also moved

in a straight line, I later shifted over to using a bent, rotating cassette, since in the straight cassette method, besides the limitations imposed on the choice of the shape of the layer, regulation of the speed also proved to be troublesome. Shortly, our so-called rotating cassette pantomograph will have been in daily use for as long as six years. It has been employed mainly in examining the jaws and parts of the face. Other parts of the head have also been pantomographed, on an experimental basis. I have further investigated the various possibilities of applying both a rotating and straight-moving straight cassette. It is my intention to write about the first-mentioned technique in the near future.

In the present paper I shall not go into the theory of pantomography or its practical application in detail, inasmuch as they have already been dealt with in several earlier articles (for example, Nos. 1—14). Pantomography need by no means be limited to the area of the jaws and skull. It is apparently applicable to radiographing the thorax and other parts of the body, too. It has also been known from the very early stages that the shape of the layer to be reproduced is not limited solely to curved surfaces but that it is possible to pantomograph flat layers as well. This is what happens, for instance, in taking pictures of the jaws. In such cases only the forepart of the cassette is bent into an arc shape, while the sides remain straight, with the result that the curved layer comprises only about one-third of the total length of the pantomogram. It should be stressed, however, that the ideal form of a layer for pantomography is a concentric cylinder, in relation to the rotational axis, because in that case the narrow roentgen beam will travel perpendicularly at every point through the layer to be radiographed and strike the film perpendicularly. The less the layer deviates from the said form, the better the result will be.

In 1950, while working in the United States^{4, 5}, I observed that the base of the skull was quite well adapted to serving as the object of pantomography. Since that time I have studied the problem both theoretically and experimentally. I have performed experiments with both living subjects and dry skulls, mostly with the latter, because our pantomograph is constructed and measured out primarily with the view of taking pictures of the jaws. Accordingly, the neck ring of the object holder is so small

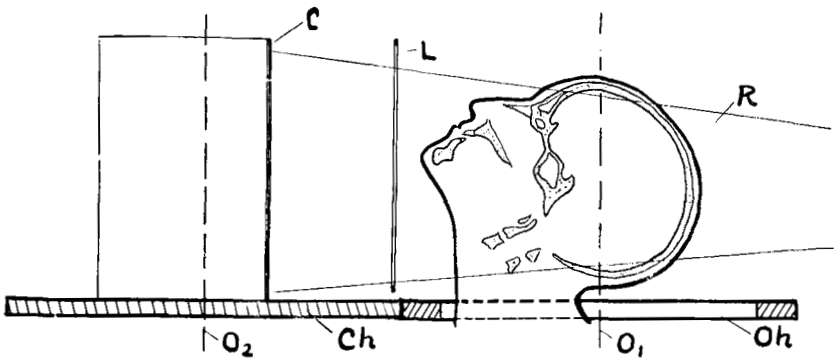


Fig. 1. Schematic drawing of pantomography of the base of the skull, viewed from the side.

that in focussing the apparatus on the base of the skull the chin of the patient will extend beyond the neck ring, which necessitates removal of the shield designed to cut off secondary radiation. This blackens the film and renders it useless.

In order that conditions may, in experiments with the dry skull, correspond to reality at least to some extent, I thrust through the foramen magnum into the cranial cavity a rubber bag, which I then fill with water. This provides the advantage that the pictures can be taken in the routine way with a voltage

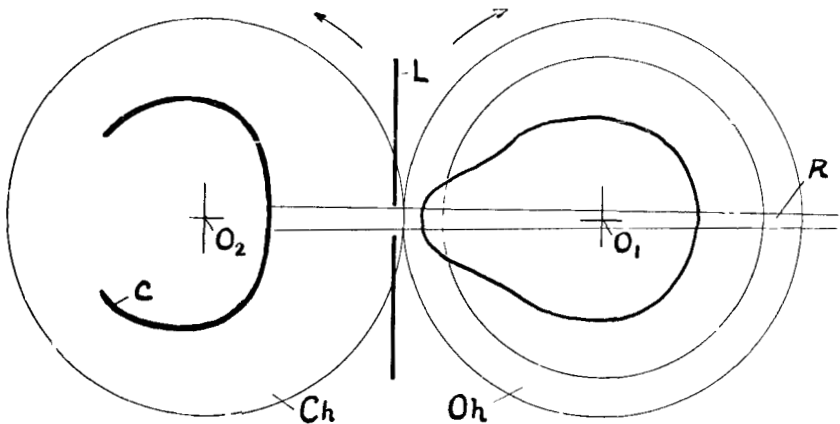


Fig. 2. Schematic drawing of pantomography of the base of the skull, viewed from above.

of about 80 kV and that double intensifying screens can be used in the cassette. Water absorbs roentgen rays considerably but does not transmit secondary radiation nearly to the same degree as do live brains and other soft tissues, through which rays must pass in radiography of the base of the skull. Thereby I was able to manage without the shield.

By and large the base of the skull is straight and situated in the middle of the cranium. It is immaterial, therefore, whether the exposure is made from in front or from behind. Pictures about equally good can be obtained both ways, especially if the pantomogram is taken stereoscopically. When facing the roentgen tube, the mandible is wholly eliminated from the picture. If, on the other hand, the mandible is toward the film with the rays travelling via the base of the skull, it will cast a faint shadow. In stereo-pictures, however, the latter seems to rise into the air and thus does not cover the base of the skull in a disturbing way. This technique gives the advantage of bringing into the same picture the sides of the skull too, i.e. parts of the temporal bone, the frontal bone and the parietal bone on either side of the base of the skull. The technique is demonstrated in detail in Figs. 1 and 2.

Fig. 1 shows a human head in median section above the neck ring (Oh) of the object holder and tilted backward to the extent that the base of the skull is in a vertical position. The chin is toward the film cassette (C), which is on the cassette table or film holder (Ch). Between the object and the film is a stationary lead shield (L), designed to protect the film from secondary radiation. This shield is curved corresponding to the shape of the outer rim of the cassette table, although in this illustration it is straight, for the sake of clarity. The holders (Oh and Ch) rotate at the same angular speed in opposite directions around their axes (O_2 and O_1). The roentgen beam (R) is directed through the head via axis O_1 toward axis O_2 , although it is absorbed by the lead sheet at the back of the cassette.

Fig. 2 represents the same arrangement viewed from above. The shape of the cassette, among other things, is better perceived.

If it is not possible to tilt the head of the patient as far backward as shown in Fig. 1, a slighter tilt will suffice as the cassette can be slanted correspondingly toward the object. This is

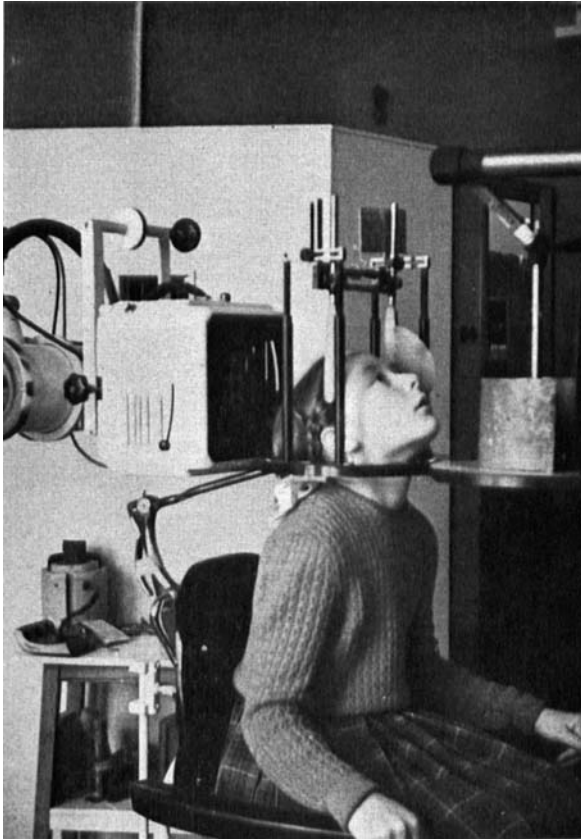


Fig. 3. A patient in the position required for pantomography of the base of the skull.

one of the advantages of a rotating cassette compared to one moving in a straight line. On the other hand, it would be advantageous to have the head tilted even farther backward in order to raise the shadow cast by the mandible higher, i.e. entirely away from the image of the base of the skull. If the neck will not bend, the roentgen rays can be correspondingly directed at an angle from above downward and the cassette table must rotate at a somewhat lower level than the neck ring so that the base of the skull will not project below the film. Thus, when the technical equipment is adjustable, it is possible to take pictures

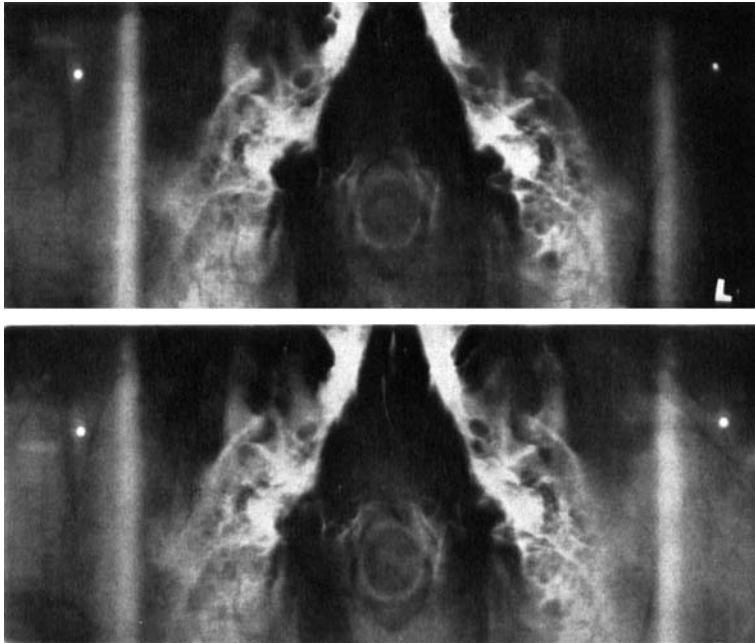


Fig. 4. A pair of stereo-pantomograms of the base and lateral portions of the skull, as obtained in the manner shown in Figs. 1 and 2.

with the rays focussed in whatever direction is required by the case at hand.

In Fig. 1 the neck ring is drawn so large that the chin can freely pass the shield (L) while the apparatus is rotating. In our present pantomograph this is not possible, Fig. 3. Fig. 3 shows a 12-year-old girl placed in the pantomograph in a position required for reproducing the base of the skull. The chin juts out noticeably beyond the neck ring, and on account of this the shield has had to be turned to the other side of the cassette table. If the chin is facing the roentgen tube, the occiput will extend correspondingly above the cassette table.

In pantomography of the base of the skull it is possible to take simultaneous exposures of several layers by placing a corresponding number of films on the cassette table. In practice this is hardly necessary, for by regulating the layer focussed on to a sufficient thickness, the entire base of the skull will

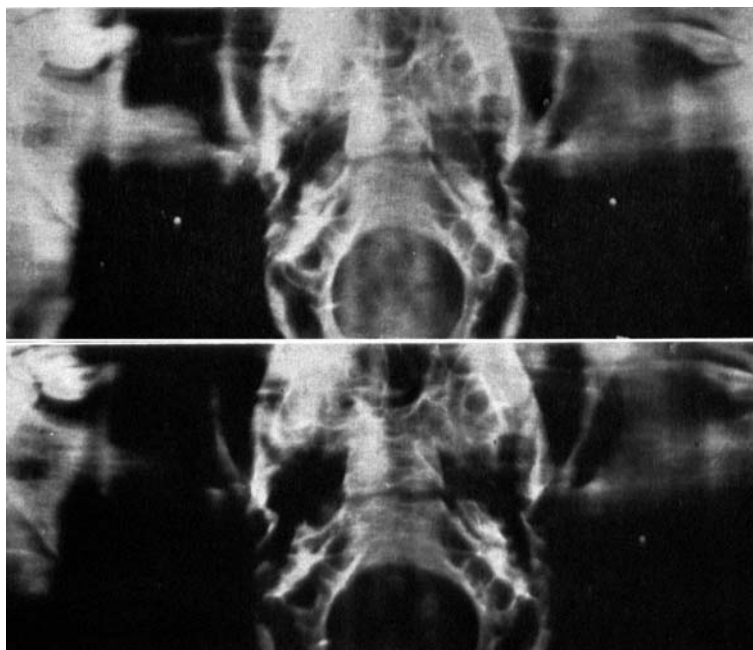


Fig. 5. Two pantomograms of the base of the skull, showing somewhat different layers, obtained by using a bent cassette and having the mandible toward the roentgen tube. Not a stereoscopic pair.

become visible even on a single film, provided it has been situated correctly on the cassette table. Expressly in stereoscopic pictures (Fig. 4) the base of the skull is admirably visible in its total thickness. If the picture is viewed "parallelly", the image will be seen from a caudal direction, or from below. In the former case the lower jaw projects toward the viewer, in the latter it has moved away from the viewer to the opposite side of the base of the skull. The light streaks appearing in the pictures are due to the bracing rods which absorb the roentgen rays excessively. In the present instance they are situated in the immediate proximity of the sides of the skull and thus are unfortunately visible too plainly. The four small, white, circular shadows are due to the control pellets attached to the ends of the ear plugs. Since they were situated against the skull bone during the pantomographic operation, they have naturally come



Fig. 6. Pantomogram of the base of the skull, taken by using an ordinary flat cassette, with the mandible toward the roentgen tube.

out clearly and rounded. The distance of the base of the skull from its rotating axis may suitably be 4—8 cm. The smaller the distance, the thinner the layer accurately reproduced and vice versa, as I have demonstrated e.g. in my paper No. 10. The thickness of the layer may be further regulated by divergency of the roentgen rays^{2, 3, 4, 10, 13}.

The pair of views in Fig. 5 were taken in such a way that the mandible was towards the roentgen tube during the exposure, while the cassette was bent approximately in the same way as described in connection with Fig. 2. As a result, the ascending rami of the mandible can be seen on both sides of the base of

the skull, while a couple of maxillary molars are dimly visible above them. The upper pantomogram reveals a slightly more cranial layer than the lower, and they do not represent any components of a stereoscopic whole.

As has been observed pantomography may be applied also for obtaining pictures of flat layers. Inasmuch as the base of the skull practically amounts to one, it can be pantomographed on a flat film. An ordinary cassette, measuring e.g. 9×12 cm, may be placed standing on the cassette table. Fig. 6 was taken in this way, with the mandible towards the roentgen tube, as a consequence of which the shadow of the mandible cannot be seen at all. I have also experimented with the use of an ordinary flat cassette in connection with the rotating cassette table with various purposes in mind, and it is my intention to describe these experiments soon.

The suitability of pantomography for examination of the base of the skull seems evident in the light of the foregoing. As a special advantage should be mentioned the relatively great accuracy of the pictures and the fact that, if so desired, the lateral portions of the skull can also be "straightened" out to the same plane as the base of the skull.

RÉSUMÉ

SUR LA PANTOMOGRAPHIE DE LA BASE DU CRANE

L'auteur a constaté grâce à ses recherches que la pantomographie convient pour la radiographie de la base du crâne. Pour la prise de la radiographie, le film peut être placé soit dans une cassette droite ordinaire, soit dans une cassette courbée spéciale, et dans ce dernier cas le même pantomogramme montrera non seulement la base du crâne, mais aussi les branches montantes de la mandibule, ou bien les parties latérales du crâne, selon que la mandibule est tournée vers le tube radiogène ou vers la cassette lors de l'exposition. Des pantomogrammes stéréoscopiques peuvent aussi être faits, ce qui garantira des résultats encore plus satisfaisants.

ZUSAMMENFASSUNG

ÜBER DIE PANTOMOGRAPHIE DER SCHÄDELBASIS

Der Verfasser hat durch seine Untersuchungen festgestellt, dass die Pantomographie zum Photographieren der Schädelbasis

durch Röntgen geeignet ist. Bei der Aufnahme kann der Film entweder in einer gewöhnlichen, planen Kassette oder in einer speziell gebogenen angebracht werden. Je nachdem ob der Kiefer beim Exponieren der Röntgenröhre oder der Kassette zugewandt ist, werden bei derselben Aufnahme ausser der Schädelbasis entweder die aufsteigenden Äste des Unterkiefers oder die lateralen Schädelteile zum Vorschein kommen. Auch können stereoskopische Pantogramme gemacht werden, die noch bessere Resultate gewährleisten.

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