Roentgenologic Diagnosis in OPHTHALMOLOGY

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Preface

This book makes available to the English-speaking ophthalmologist advances in the field of roentgenology, and to the roentgenologist the apparatus and the technics most important to the ophthalmologist.

Various procedures described by other authors for the roentgenologic examination of different parts of the skull are outlined and critically examined, but, fortunately, the authors have usually stated their own technics, opinions and modifications. Both ophthalmologists and roentgenologists are greatly indebted to them for this excellent scrutiny of old procedures and for an introduction to the newer methods. The resulting improvement in the use of the now more than 3-score-old discovery of W. C. Roentgen will certainly benefit all concerned and, most of all, our patients.

The translators acknowledge with pleasure their indebtedness to all persons who were of assistance during the preparation of this volume. Mrs. Renata Kalfus-Taffet helped with the translation of the final 4 chapters. Mrs. Amy MacNall, Miss Ann T. Parsons and Mrs. Helen Sells have typed and retyped the manuscript with many helpful suggestions. Dr. John Wentworth and Dr. Judah Zizmor generously checked the manuscript for accuracy from the roentgenologist's point of view. Finally, Mr. Brooks Stewart of the J. B. Lippincott Company gave valuable advice and help in arranging for the publication of this volume.

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CONRAD BERENS, M.D.

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Introduction

This book requires a few explanatory lines.

In 1929 the French Society of Ophthalmology and its secretary, Mr. René Onfray, decided to devote one of their annual reports to the use of roentgenography in ophthalmology, and they charged one of us with this work. After close to 5 years of work on it, *The Atlas of Clinical Radiography in Ophthalmology* was published in April 1936.

Although 1800 copies were published, the book was soon out of print, and the author flinched whenever asked to rewrite it. He did not wish to think of it again, once the press-proof was corrected and signed. However, as the years went by, it seemed to become more difficult to rewrite this report, for both roentgenology and ophthalmology had advanced. It would have meant preparing a new bibliography, studying new technics and almost completely rewriting a book, since the author, as an ophthalmologist and not a radiologist, had become interested in other problems.

In the meantime, the present co-author, a radiologist, owing to certain circumstances and her close association with the ophthalmologists of the *Quinze-Vingts* in particular, had frequently seen patients with ocular diseases and examined many of them roentgenologically.

Thus the combination in Paris of an ophthalmologist interested in radiology and vice versa might offer new possibilities. The author's friend, Pierre Porcher, with his usual foresight, was the first to suggest this combination. Those who know him will understand why the author could not possibly refuse and had to undertake the task. Therefore, this book is his work above all, and it would only be fair to have his name on the cover.

This book is not a revised and enlarged edition of the 1936 report but an entirely new work. It is different in its content and spirit.

The book of 1936 was a report written by an ophthalmologist for ophthalmologists, as part of the series of annual reports of the French Society of Ophthalmology. It dealt with fairly new and little-known subjects and was therefore somewhat limited. As the book was written by an ophthalmologist and for ophthalmologists, it omitted the entire technical aspect, merely summarizing the ocular findings corresponding to the roentgenograms. Since it was a report, it was undesirable for the author to stress his own ideas or the technics he preferred. He had to write a general review followed by a critical analysis. This led to the writing of detailed chapters on the localization of foreign bodies and roentgenography of the optic canals. Those chapters, as well as some others, were rather lengthy because at the time the book was written the technics were comparatively new and rarely used.

The present book is written in an entirely different spirit. Its *principal object* is to be practical and to serve as a reference for the roentgenologist or ophthalmologist who may have difficulty in solving a problem encompassing these two specialties. This book is part of the series of works on radiology published in recent years and should *contain* all technical information pertaining to roentgenology.

Many questions which were controversial in 1936 have since been clarified. Therefore, it was possible to abridge markedly some chapters. On the other hand, however, some new technics account for the addition of certain chapters which were omitted in 1936. This is particularly true with regard to *tomography*. The author of the 1936 report had devoted a short chapter to it (and it was, we believe, the first French publication since the brilliant theoretical annotations of André Bocage in 1921 to describe this technic). But "planigraphy," as it was then called, was a new concept, and necessarily a more detailed chapter was desirable for this book.

Also, the author must indicate and justify another difference between the two books. The 1936 report devoted 72 pages, or more than one fourth of the book, to roentgenography as related to neurology and neurosurgery, with regard to visual difficulties of intracranial etiology. This proportion was extraordinary but necessary at that time, since this type of roentgenologic examination was not a standard procedure and deserved better understanding. The author of the 1936 report worked together with Clovis Vincent and his assistants at the Neurosurgical "Clinique de la Pitié" and had their great collection of roentgenograms at his disposal. To have his colleagues, who did not have the same opportunity, benefit from his experience seemed only a natural desire.

At present, and probably partly because of the 1936 report, the ophthalmologists and radiologists are familiar with these problems, and a detailed chapter on this subject would have been superfluous. Therefore, the author has condensed it, referring those who may have a deeper interest in these questions to works dealing with this subject.

What the author has just written will explain, even better than the laziness of one of the authors, why he never desired to undertake the work he had done in 1936 without assistance. A radiologist had become indispensable and unaided probably would have been unable to write the present book. The task of the two authors of this book has been different. If one pioneered in a more or less virgin subject 20 years ago, the other did most of the work on this book.

To do justice, the names on the cover should have appeared in an entirely different order or print. It is only in deference to the past that they have been placed as they are.

EDWARD HARTMANN

1

General Considerations

Roentgenography of the skull is particularly difficult because of the unavoidable superimposition of images. This results from the fact that a 3-dimensional structure, abundant in details, is projected on one plane. It holds even more true for roentgenography of the face.

It will be shown presently how special roentgenologic technics can help to eliminate troublesome superimpositions more or less completely. But, whatever methods are used, 3 factors are essential for obtaining satisfactory roentgenograms:

1. The symmetry of the picture.
2. The clarity of the picture, possible only when the patient is adequately immobilized.
3. The photographic quality of the picture. This is determined by the choice of exposure, the limitation of the field and the elimination of scattered radiation.

SYMMETRY OF THE PICTURE

Many procedures have been described for accurate estimation of the symmetry of the picture. Cottenot used centration by a scout film. Porcher advised a more simple and faster procedure: he evaluated it by observing the symmetry of the projected shadow.

Indeed, it seems that the symmetry and the degree of rotation of the head can, with a little practice, be appreciated easily by the roentgenologist when he sits on a low stool at the head of the table. From this location he can best evaluate the position of the head in respect to both its level and its axis and thus ensure exact duplication of positions for the right and the left side in cases where symmetrical positions are required (optic canal, sphenoid fissures).

IMMOBILIZATION

The authors have already pointed out that it is mandatory, not optional, to produce and read roentgenograms of the skull which represent true frontal views or true lateral views, regardless of the position or the degree

of flexion or extension. Only in this way can the roentgenologic examination of the skull provide information that is complete and comparable from one examination to another. Therefore, perfect immobilization is essential. This is not easily accomplished, especially in certain positions which allow only a very unstable support.

The patient should be co-operative, intelligent, calm and patient. Consequently, his age (infant), state (conscious, unconscious, excited) and possible neurologic condition (e. g., parkinsonism) influence the result.

To obtain and maintain immobility in the chosen position, simple means (blocks for forehead or chin) or more complicated contrivances (firm immobilization by triple clamps, or even general anesthesia) must be used, according to the case.

In lateral views angled blocks are used for the chin and blocks with rounded depressions for the forehead or occiput; they are made of cork and therefore are transparent to the x-rays and easy to make and adjust. Usually a set of 3 or 4 blocks, 1 angled and 2 or 3 rounded, of a radius of 10 to 12 cm., is sufficient.

When the patient is unable to maintain sufficient immobility without effort, blocks may be supplemented by a linen headband which must be tightened with two cranks to prevent pulling the head in one direction or by blocks for lateral support, of which numerous models are available. Usually these blocks are of ebonite or cork mounted on rods sliding vertically and transversely; they are adjusted individually, without pressure.

The simple contact of lateral blocks applied in such a manner is not only sufficient to establish immobility of the patient but also allows enough

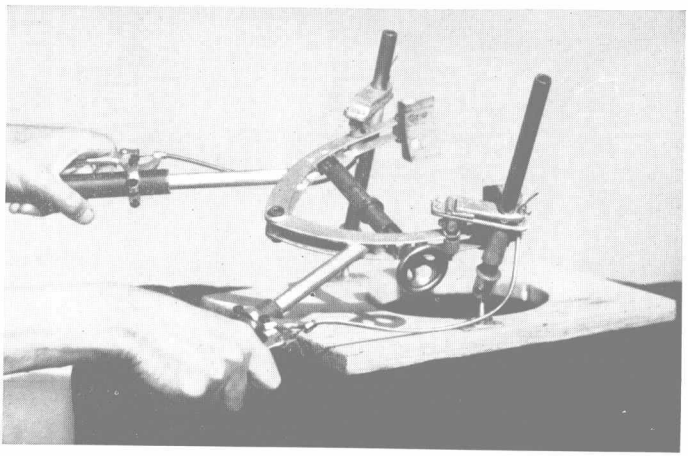


FIG. 1. Double clamp.

time for taking stereoscopic pictures or developing trial exposures, even if the position is uncomfortable (e.g., nose-chin).

The roentgenologist must sit at the end of the table in such a manner that his visual direction, parallel with the ground, enables him to evaluate the proper degree of symmetry, the support and the degree of immobility which the patient maintains. After he assures himself that the degree of extension or flexion is proper, everything is ready for taking the picture.

An example of the simplest case: the relaxed patient maintains a satisfactory immobility in a comfortable, easily assumed position, with the aid of the above-described lateral support if needed; his head is steadied between the hands of the roentgenologist who flexes or extends it after having determined its position.

When the patient appears to be co-operative but is unable to maintain adequate immobility, additional means must be used: a triple support in the form of 3 blocks, i. e., 1 frontal and 2 lateral blocks or a double clamp which may be fastened to the table and is closed by the hands of the radiologist; some of the clamps are provided with a catch. The double clamp can be placed at the head of the table (Figs. 1 and 2) and, if necessary, can be supplemented by a frontal support. The latter is adjusted after the head has been steadied in the proper position. It helps to secure adequate immobilization and to prevent any changes in flexion or extension. The choice of the method of immobilization depends upon the difficulty of the required position and on the patient, i.e., whether he is simply un-co-operative or lacks understanding without being resistant.

In case of an infant or a very young child, usually it is necessary to "use

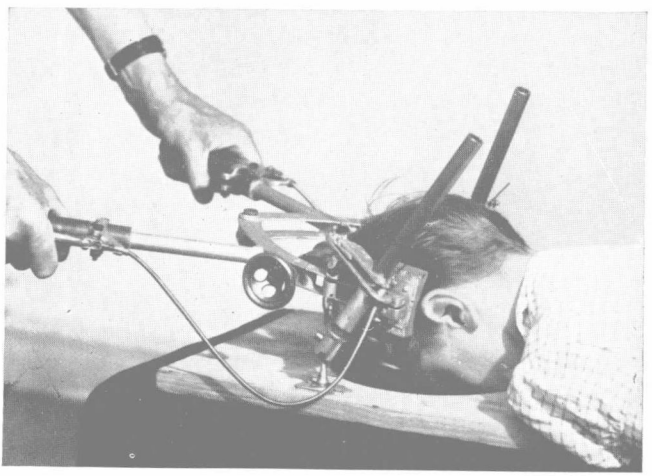


FIG. 2. Head immobilized by the double clamp.

your hands"—in gloves, of course—if the necessary minimum of immobility in the chosen position has to be secured; in fact, even a tightly adjusted strap would not resist the amazingly strong movements of a child.

Except in the case of the fracture of the skull, the unconscious, comatose patient must be held more firmly if the symmetry in the chosen position has to be obtained and maintained. The double clamp (Figs. 1 and 2) is generally insufficient despite the excellent grip of its parts. In spite of the legitimate reluctance on the part of the roentgenologist and his aides to "put their hands" in the rays, there are cases where it is unavoidable; however, the glove provides an adequate protection, since the cone can limit the field, leaving the hands of the operator outside the field.

The occasionally necessary general anesthesia does not exclude, of course, the necessity of immobilization, but firm immobilization usually can be dispensed with.

CHOICE OF EXPOSURE

In roentgenography of the skull, the choice of exposure is most important for obtaining pictures with good contrast giving the impression of a "dry skull" without showing the soft parts.

The details of the plate are dependent upon the focal spot of the tube and the target-to-film distance. The contrast is dependent upon the constancy of the voltage used, the use of a good Potter-Bucky diaphragm and the limitation of the field. The anodes used in the modern equipment are fine: rotating anodes with 1.0 mm. or 0.3 mm. focal spots; magnification can be obtained only with these. The distance is usually 1 meter.

Of course, the limitation of the field depends on the area to be encompassed, but for all the special roentgenograms, i. e., orbits, optic canals and sphenoidal fissures, a restricting cylinder is used, 40 cm. long and 6 cm. in diameter; it makes the use of a centering device unnecessary.

The following are the standard values used:

Frontal		
Nose-Chin	60 Kv.	100 ma., 2 sec.
Forehead-Nose	58 Kv.	100 ma., 2 sec.
Hirtz	63 Kv.	100 ma., 2 sec.
Lateral	48 Kv.	100 ma., 2 sec.

It is understandable that the given times of exposure cannot be used in agitated patients or in children, and to shorten the time of exposure either the milliamperes or the kilovolts must be altered, depending on the efficiency of the generator.

2

Walls of the Orbit

ROENTGENOLOGIC TECHNIC

Systematic examination of the walls of the pyramid formed by the bony orbit requires several views. For practical purposes, it is necessary to take pictures all around that pyramid.

Frontal View

Most important is the nose-chin-plate position (standard frontal view) because it permits a composite view of the bones forming the orbit. Both orbits should be photographed on the same plate so that their dimensions and density may be compared.

Examination of the Roof of the Orbit. In the technic of the American authors, Blondeau or Waters, the patient's chin rests on the cassette but the nose does not touch it. The central ray passes through the orbit. Such a view reveals the superior orbital wall.

Examination of the Floor of the Orbit. The standard frontal view and Blondeau's projections appear to be most suitable for examining the floor of the orbit.

Examination of the Inner Wall of the Orbit. The inner wall of the orbit is photographed by means of oblique views: a somewhat oblique view as used in the projection of the sphenoidal fissure (see Chap. 4, p. 39), or a very oblique view as employed in the projection of the optic canal (see Chap. 3, p. 21).

Examination of the Outer Wall. The oblique temporo-orbital projection of Belot-Fraudet is preferable for examining the outer wall of the orbit. In this technic a very oblique, tangential projection is used to take a roentgenogram of only one orbital cavity. This is the best method of avoiding superimposition of the bone images. The patient is placed in a prone position. His head is turned so that the supra-orbital ridge, the zygomatic bone and the side of the nose opposite to that which is being roentgenographed rest on the cassette. The vertical ray, which is centered in the temporal fossa, passes through the assumed center of the eyeball and emerges somewhat outside the nasal bones. In determining the exposure, the thin-

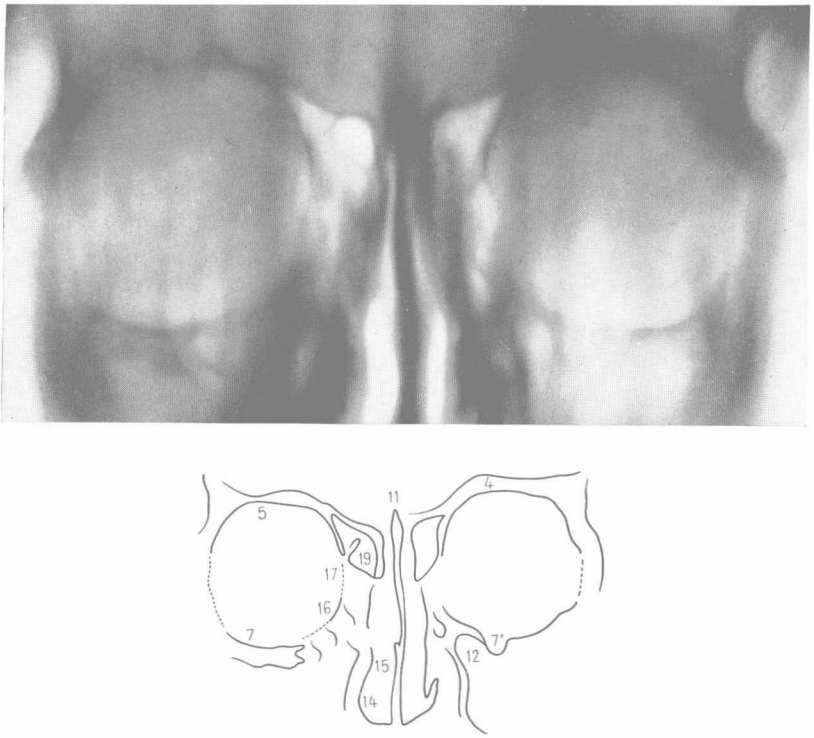
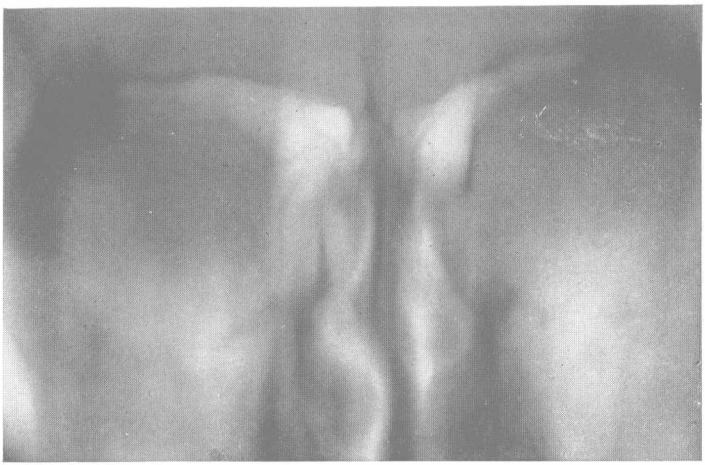


FIG. 3. Frontal tomogram (forehead-nose projection). Section at 2 cm. (1) Frontal sinus. (2) Sphenoid ridge. (3) Anterior clinoid process. (4) Upper orbital margin. (5) Roof of the orbit. (6) Superior orbital fissure (medial part). (7) Floor of the orbit. (7′) Infraorbital canal or notch. (8) The great wing of the sphenoid bone. (9) The innominate line. (10) Posterior ethmoid sinus. (11) Crista galli. (12) Maxillary sinus. (12′) Inferior orbital fissure. (13) Turbinate bones. (14) Nasal walls. (15) Nasal septum. (16) Inferomedial part of the orbit. (17) Inner wall of the orbit (os planum). (18) Small wing of the sphenoid bone. (19) Frontoethmoid and ethmoid cells.



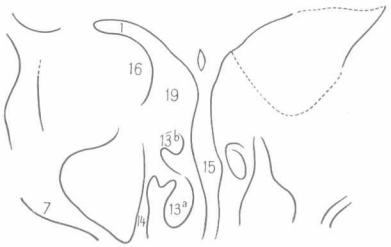


FIG. 4. Frontal tomogram.
Section at 3 cm.

FIG. 5. Frontal tomogram.
Section at 4 cm.