

# The Radiological Diagnosis of Defects of the Skull Vault\*

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## SUMMARY

Many skull defects have characteristics by which they can be readily recognized. In others, adequate routine examination usually turns up similarly recognizable patterns. The cases remaining for further differential diagnosis are few in number. Skull defects serve as an illustration of the reasonable approach of today's radiologist to differential diagnosis in general.

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A skull vault defect will serve as well as any lesion to illustrate the progress which has been made in the method of standard consulting-room approach to radiological diagnosis in the time of our own generation.

In 20 years we have all grown out of the protective covering of longwinded verbal descriptions, through the stage of what we were pleased to call differential diagnosis, to the present, desirable position where a radiologist, in consultation with his clinical colleagues, attempts a decision which may make responsible action possible.

Today's referring doctor is no longer content with wordy descriptions of appearances. He who has a map in his hand

won't read a verbal description of the shape of the Mediterranean. Your doctor has no respect for a list of possible causes, of which the usefulness varies inversely with its length. Firstly, he knows by now that every lesion may be due to congenital, traumatic, vascular, inflammatory or neoplastic causes. Secondly, he has a patient to deal with, and he could drive his patient mad by telling him: 'The specialist says you've got a hole in your head which may need an operation, but, on the other hand could be merely an anatomical variation or, again, may be fatal anyway'.

In practice, we make radiological diagnosis by one or more of 4 processes: guessing; brilliant deduction, which is akin to guessing; statistical probability; and simple recognition.

## SIMPLE RECOGNITION

Most of our diagnoses, and certainly our best diagnoses, are made by the simple recognition of appearances with which we have become familiar, and not by a process of conscious or selfconscious logic. The admission does not shame us. It is the way in which the human mind works, and works with incredible efficiency. The most stupid of us can recognize other people immediately and unerringly without being able to recall the colour of their hair or

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which of them wears a moustache. We recognize acquaintances out of all the thousands we know and the millions we don't know. We still recognize them when they colour their hair and lengthen their skirts and through other disguises. We even recognize people by such subtle things as mere outline, a gesture or a voice, which we would find it hard to describe to others, and harder to recognize from a description.

Many skull vault defects are easily recognizable by their characteristic appearance: acute osteomyelitis which is invasive, with sequestration; chronic osteomyelitis which is circumscribed, with sequestration and regional sclerosis; dermoid and epidermoid cyst, in the midline or sutural position, rounded and with corticated margin; meningo-coele of which the defect resembles a dermoid, but with a larger mass. Haemangiomas are almost always recognizable for what they are, with their crenated margins, radially grooved periphery or pitted centre. 'Doughnut' lesions no longer require biopsy—enough biopsies have been done to know that it would show a fibrous nodule within a raised rim on the outer table, presumably due to old subepicranial haematoma from previous injury. An arachnoid cyst produces what is obviously a fracture with its margins widely separated by the arachnoid cyst, pulsating through a dural tear.

### STATISTICAL PROBABILITY

For skull defects which lack an easily recognizable appearance, we have to rely on statistical probability. Radiologists have known for years that almost all large osteolytic lesions in the pelvis without other distinguishing features, turn out to be malignant metastases or plasma cell myelomas. The skull is similar to the pelvis in being another flat, vascular, cancellous bone with a cortical layer on each side, but modified by its outer covering of vascular scalp and its inner relationship to meninges and brain. Brain lesions which produce skull defects usually present as brain lesions and scalp lesions which produce skull defects always present as scalp lesions. This leaves us with the same general principle, that, though there may be 40 more or less common diseases which cause skull vault defects, a large, ill-defined defect in the adult skull vault, without other distinguishing features is usually a malignant metastasis—if we include under this group such diseases as lymphoma and myeloma.

### INVESTIGATION SAFER THAN DEDUCTION

A routine X-ray examination of the skull (or any other part) may produce an appearance which is not recognizable as that of a condition with which we have become familiar. We may be able to make the diagnosis in such a case by guessing or by brilliant deduction. The trouble with this process is that it requires brilliance and considerable luck. It is usually simpler, safer and more rewarding to follow the standard procedure of all practising radiologists:

- (i) to go back for more clinical information,
- (ii) to modify the local examination in an attempt to produce an appearance which may be recognizable, and
- (iii) to extend the examination to other parts of the body.

A successful radiologist is rarely a genius or a man with the memory of a computer. More often he is a humble plodder who is prepared, once again, to go through the boring routine of hunting for more evidence, hoping to turn up a clue which is easier of interpretation. The air in a scalp laceration may resemble a wide vault fracture in the eyes of a beholder who has not seen the patient. A large vault defect which would be difficult to understand on the X-ray appearance alone may become reasonable with the knowledge that it had followed a severe burn. We all recall that, if not most of our mistakes, certainly the most foolish of our mistakes are due to ignorance of *clinical facts*. We have all complained for years about clinicians who fail to provide us with necessary particulars. We begin to realize that, so long as we rely on others for our clinical information, so long shall we continue to be seen making a spectacle of ourselves.

### LOCAL EXAMINATION

In the investigation of skull vault defects *the local examination* always includes two tangential views, one for bone and one for soft tissue. The tangential view is most easily assured by sticking a neat ball bearing to the surface and obtaining the tangent with the collimator's light beam (Fig. 1). The soft tissue film can be exposed simultaneously with the bone film by placing a non-screen film holder on the outside of the cassette. The effect of such combined films is neatly shown for a lesion like a dermoid cyst overlying a vault defect.

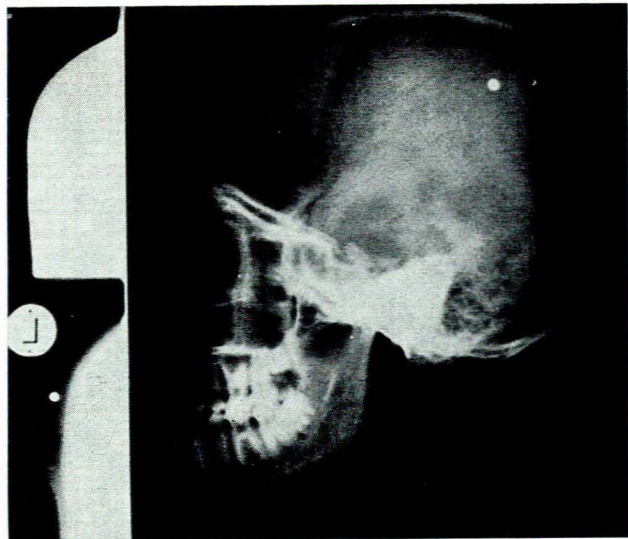
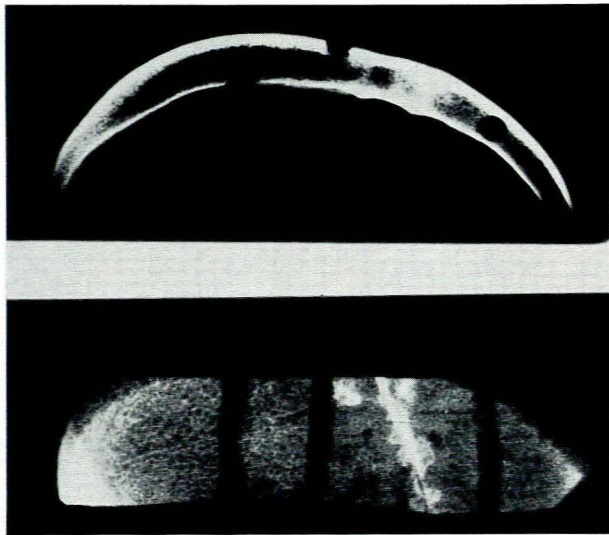


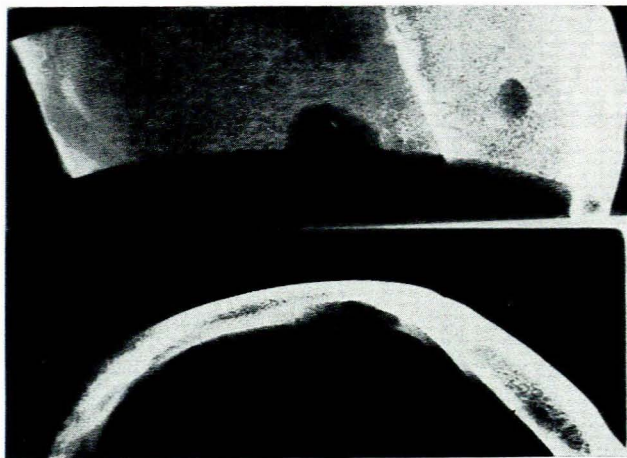
Fig. 1. Lateral and tangential views, with marker.



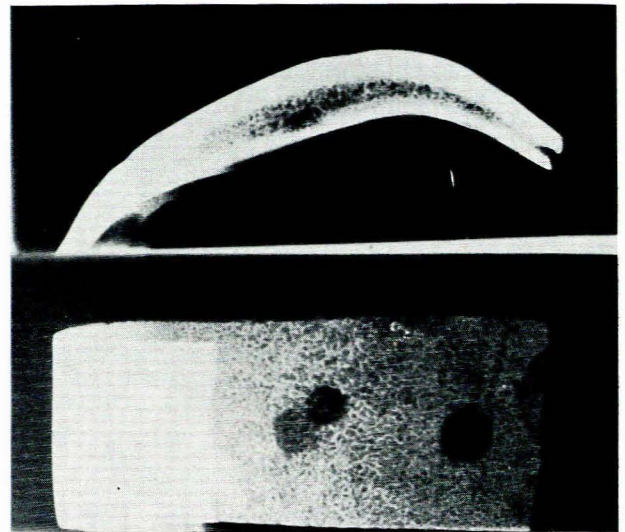
Without a tangential view we lack the elementary knowledge of whether a defect originates in the inner or outer table or in the diploic layer, or is even limited to one of these layers (Fig. 2). However, the tangential view has its own limitations: a purely diploic defect may resemble an inner table erosion, because of the variations in thickness of the skull and thinning over inner table depressions (Fig. 3). Again, even large defects may be entirely invisible on tangential view, because of the depth of bone which casts a shadow. Thus, even in a 4 cm wide fragment of skull vault, holes of 1 cm diameter in the inner table, the outer table or right through the skull thickness, may be hardly visible in lateral projection, yet very obvious in frontal view (Fig. 4).



**Fig. 2.** Lateral and frontal views of 3 grooves cut in the inner table, outer table and diploic layer of a 4-cm wide fragment of skull.



**Fig. 3.** Frontal and lateral views of a large diploic cave.



**Fig. 4.** Frontal and lateral views of 3 defects: inner table, outer table and total perforation.

### THE DISTANT EXAMINATION

In a patient with a skull vault defect this examination always includes chest X-ray and skeletal survey. For the skeleton, we do 10 films: one each of the 8 halves of the 4 limbs, one lateral of the dorsal spine and one antero-posterior of the lumbar spine and pelvis. The skeletal survey may expose a related lesion which is easier to recognize, as in malignant metastasis, myelomatosis or histiocytosis X. In children, ill-defined skull vault defects are not usually due to metastasis but to histiocytosis X, sometimes with lesions in the rest of the skeleton, quite often in the mandible.

A brilliant diagnosis of an awkward skull vault defect may be made possible by a simple chest film which shows a primary or secondary malignant tumour.

### THE HELP OF A COMPUTER

Finally, we may wonder how much help or hindrance the computer may become in radiological diagnosis, as of skull vault defects. It is not unlikely that we shall soon have a computer at our disposal which has been taught by a group of experts to memorize all the facts necessary for the diagnosis of skull vault defects. All that would remain in a problem case would be for a trained observer to supply the computer with the exact details of the appearance of the defect, and the clinical findings, and the appearance of tangential views, and the result of a chest X-ray and a skeletal survey.

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