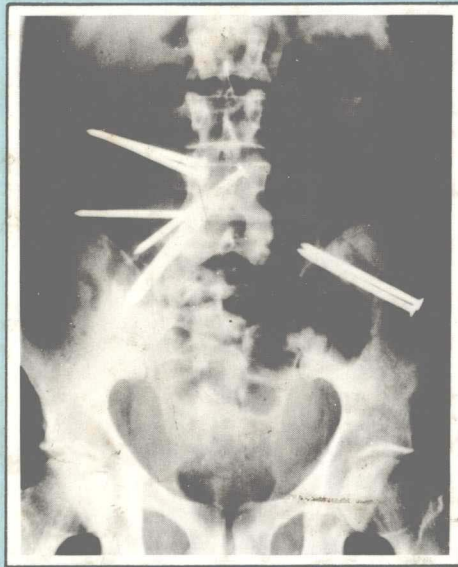


# CASUALTY RADIOLOGY

A Practical Guide for Radiological Diagnosis

*Paul Grech*



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# Casualty Radiology

## A Practical Guide for Radiological Diagnosis

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**Paul Grech**

M.D. F.R.C.R. D.M.R.D. D.T.M. & H.

Consultant Radiologist  
Northern General Hospital,  
Lodge Moor Hospital and  
King Edward VII Orthopaedic Hospital, Sheffield  
Honorary Clinical Lecturer in Radiodiagnosis  
University of Sheffield

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## CASUALTY RADIOLOGY

Also by Paul Grech

**HIP ARTHROGRAPHY**

The possibility of 'isolating details from surroundings' as Mr. Gernsheim puts it, is in my opinion, the photographer's greatest privilege. He can stop you to concentrate on something which the eye, roving over the whole . . . may miss completely.

Nikolaus Pevsner in a Foreword  
to *Focus on Architecture and  
Sculpture* by Helmut Gernsheim,  
Fountain Press, 1949

The eyes without the mind would perceive in solids nothing but spots or pockets or shadows and blisters of light, chequering and criss-crossing a given area. The rest is a matter of mental organisation and intellectual construction.

Bernard Berenson in *Aesthetics,  
Ethics and History*

### *Contributors*

**Maurice Hindle,**

T.D., M.D.S., F.D.S.R.C.S.

Senior Lecturer, University of Sheffield.

Honorary Consultant Dental Surgeon,

Northern General Hospital, Sheffield

**D.R. Naik,**

M.B., Ch.B., F.R.C.R., D.M.R.D.

Consultant Radiologist,

Northern General Hospital, Sheffield

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## Foreword

Sir Harry Platt Bt., LL., M.D., M.S., F.R.C.S.

Emeritus Professor of Orthopaedic Surgery,  
University of Manchester  
Past President Royal College of Surgeons of England.  
Honorary President International Federation  
of Surgical Colleges

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This is a comprehensive monograph on the essential role of Radiology in the accurate and early diagnosis of the less spectacular skeletal and joint injuries – the trauma mainly of the ‘domestic environment’. Its theme, however, is equally applicable to the more violent situations of the major and multiple trauma of road traffic, heavy industry, and the like.

The reputation of a hospital in its immediate catchment area often depends on the quality of the results obtained by the Casualty or Accident Service in this wide field of trauma, often misnamed ‘minor injuries’. Precise radiodiagnostic ‘vision’ means looking first in the right place, and being ready to extend the search in injuries known from past experience liable to involve different skeletal levels. It means also a scrutiny of the evidence of soft tissue injury. Such information is invaluable to a Casualty Officer called upon to initiate the first stage of the treatment of the injured patient.

All this presupposes the creation in a hospital of easy and prompt lines of communication between Casualty and a Radiodiagnostic Unit. Dr Grech rightly emphasizes that such an organization implies a two-way traffic between interested and alerted minds. After reading the final draft of this admirably lucid monograph, I feel that it is more than a primer for Casualty Officers. It is much more. It is an important contribution to the art of clinical diagnosis and should take its place as a book of reference, both for the Senior Registrar and Consultant Orthopaedic–Accident Surgeon.



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## Preface

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I have noticed for some years that many young doctors and also some trainee radiologists have difficulty with the radiological evaluation of certain skeletal injuries. This may be because radiology of trauma is not usually systematically covered in undergraduate teaching programmes, and also because trainee radiologists are often left to themselves to report on casualty radiographs without adequate supervision, due to the erroneous idea that all fractures are easy to diagnose. They soon discover that there is a lot about trauma they do not know.

I thought it might be worthwhile to put together in the form of a book the diagnostic difficulties encountered, stressing on the more important pitfalls by the help of illustrating case reports, hoping that the readers will avoid making mistakes by benefiting from those committed by others.

This is meant to be a handbook dealing with common injuries that are not so easy to see on the radiographs and similar pitfalls encountered by the casualty officer and his equivalent in the Emergency Departments of American hospitals. It is based mainly on material seen at the Northern General Hospital, Sheffield. It is devised mainly for the medical student, the fresh houseman and Casualty Officer to give them guidelines to help with the interpretation of radiographs and the radiographic management of such cases. It is also hoped that this handbook will be considered as a 'primer' in traumatology for the trainee radiologist.

The aims of this book are limited. It is not meant to be an exhaustive atlas of fractures; obvious fractures are not included, but stress is made on the common not-so-obvious ones. The severe injuries which merit hospitalization and those examinations which involve contrast media and other specialized radiological investigations where the radiologist is involved, are not included in this study. Its object is simply to make available in one small volume the normal radiographic appearance and such findings which have proved to be a trap for the unwary or inexperienced doctor.

P.G.  
Sheffield

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## Acknowledgements

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It is never possible to thank all who have helped in some way or other to complete this book, but I would like to acknowledge my gratitude to Mr R.A. Elson and Mr T.W.D. Smith, Consultant Orthopaedic Surgeons at the Northern General Hospital, Sheffield, for their continuous support and the encouragement over this project. Some of the radiographs have been generously given by radiological colleagues and I would like to thank them for their contribution.

Most of the contents of this book are based on tutorials given to our trainees; I would like to thank the many generations of registrars who helped me in keeping records or in bringing interesting cases to my attention.

I am especially grateful to Sir Harry Platt, Bt., for reading the manuscript, for his suggestions and for agreeing to write the *Foreword*, and to the Medical Protection Society and the Medical Defence Union for their advice and permission to include material from their annual reports. This work contains contributions by Dr D.R. Naik (Chapter 11), and Mr M.O. Hindle (Section 6.2.2); I am indebted to both these colleagues for giving unstintingly of their time and expert knowledge.

A major contribution of this book is its illustrations and I would like to thank Reg Brooks, Senior Medical Photographer and John Williamson, Medical Artist, and their staff at the Northern General Hospital, Sheffield, for their patience and expert work. I am grateful to Professor Robert Shapiro for allowing me to reproduce the radiographs shown in Fig. 7.16. My thanks are also due to Alan Robinson, Senior Physicist, Sheffield Area Medical Physics Department, for the study of glass particles in wax phantom, and for Figs. 12.1 and 12.2, and to K.G. Porter of the Statistics Division, Trent Regional Health Authority for the information contained in Tables 6.1 and 6.2 concerning the incidence of head injuries.

Finally, I wish to express my gratitude to Winn Grocock and Susan Tingle for their assistance and tedious task of typing the manuscript.

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## 1 · Introduction

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The importance of radiology in patient management is now well established. Diagnostic radiology is now the most expensive speciality, consuming some 10 per cent of the yearly budget of a teaching hospital (Soila and Maurer, 1973). The volume of radiographic work in the average hospital is increasing by some  $7\frac{1}{2}$  per cent per year. This increase in X-ray requests raised the suspicion that there might be over-usage of the speciality. It is now widely suspected that there is a fair amount of unnecessary radiological investigation being carried out. An appreciable amount of these unnecessary X-rays are suspected to occur in accident cases when radiography is requested purely for medico-legal reasons, so that the doctor 'covers' himself. This topic has been thoroughly discussed in the correspondence columns of the *British Medical Journal* (1969–70), and, more recently, Mayer (1976), called for an end to all 'these defensive X-rays'. It is perhaps time that the legal aspects be examined by the medical profession and guidelines be laid down to fight this present tendency to regard non-usage of radiography in injuries as almost amounting to malpractice. The Royal College of Radiologists is so concerned about this over-usage of X-rays, that it has set up a working party to look into this problem and suggest ways in which it might be solved.

The most common instances of unnecessary X-rays are:

- (a) When radiography is used instead of an examination.
- (b) When X-rays are requested because the patient or the patient's family expected or wanted them.
- (c) When X-rays are not properly interpreted, or not examined at all, once they are taken.

The examination of a patient and the assessment of the medical history is mandatory before radiographic examination is requested. Radiographs may form an essential part of the examination and without them, in some cases, a correct diagnosis is impossible. However, one must first know what injury one is hoping to confirm or refute and unless a clinical examination is carried out beforehand this cannot be done. The provision of X-rays by itself is not sufficient to show that reasonable care has been exercised. Once it is decided, after the physical examination, that X-rays are indicated, relevant clinical information

should be given on the request card so that the suspected part of the body is properly and adequately radiographed.

There is a common attitude among the lay community, that unless radiography has been carried out, the case has not been adequately examined. Too often young doctors, and sometimes the senior ones, give way on this point. X-rays should not be used as a placebo or to satisfy the patient or their families. Unnecessary radiographic examinations must be curtailed on account of the potential hazard of irradiation. James *et al.* (1970), suggested that a referring clinician should ask himself two questions before sending a patient for X-ray examination:

- (a) What information does he expect to gain from the examination?
- (b) Will this knowledge affect the management of the case?

If he does not know the answer to the first or the answer to the second question is 'no', then it would appear that the examination should not be carried out. In other words, if, on clinical examination, there is evidence or suspicion of bone injury, an X-ray is indicated; or if the doctor is in doubt, the patient should be X-rayed; but if the clinical history and examination do not suggest the possibility of skeletal injury, radiography should not be requested.

The Defence Societies are sometimes wrongly quoted as advising that radiographs be taken for legal purposes. Perhaps one should stress this point by quoting from the *Medical Protection Society Annual Report* (1975) that doctors 'should feel under no pressure to practice defensive medicine to the ultimate detriment of patients or to feel that for their own safety patients should be exposed to the potentially harmful effects'.

Having decided on X-raying the patient, it is the doctor's responsibility to ensure that all important and useful information contained in those radiographs, is noted. The inspection of the radiographs should be done in a systematic fashion and not just a cursory look often by holding the radiograph to a window! For optimal visual detection, radiographs must be viewed on good viewing boxes and in satisfactory ambient illumination.

The doctor, inspecting the radiographs, should satisfy himself that:

- (a) the radiographs are of that particular patient;
- (b) the radiographs are of acceptable quality and are sufficient in number;
- (c) the area that is being examined is adequately demonstrated; and finally,
- (d) that he has sufficient knowledge and experience to interpret the findings; if not he should seek help and guidance.

Perhaps it might be relevant to consider here the contribution of the radiologist to the accident department. This differs from

one hospital to the other, depending not only on the hospital itself and the staffing complement of the X-ray Department, but also on the attitude of the clinician and the interest of the radiologist. Briefly it varies from the ideal where all radiographs, including those from the Accident Department, are inspected and reported upon straightaway by the radiologist, to the unsatisfactory and unacceptable position where casualty radiographs are never seen by a radiologist.

In the United Kingdom the majority of the hospitals provide only a limited 'reporting service' on casualty radiographs; some restrict reports to radiographs of chest and skull and others report only on those cases that are specifically referred for an opinion.

Most radiology departments will not accept patients with suspected fractures referred directly by general practitioners, taking the view that all injuries should be referred to Accident Departments right from the beginning. Such a directive was given in a circular, when open-access was first established in our hospital; yet injuries are still occasionally being referred for radiography from the family doctor. The reason behind such a directive is to avoid unnecessary work on the radiographic staff, since when a fracture is noted, they will have to arrange for the patient to be seen and treated by the Casualty Officer. On the other hand, a fracture may not be seen until the radiographs are examined by the radiologist, by which time the patient would have left the department.

The method of reporting on 'casualty' radiographs in our hospital is as follows. Radiographs of all casualty cases are not immediately reported by the radiologist; they are sent with the patient directly to the Casualty Officer who examines them and makes a note of his findings on the case-notes; patients who have fractures or other injuries diagnosed by the Casualty Officer are referred directly to the Fracture Clinic or appropriate department.

All casualty radiographs are inspected and reported by the radiologist the following morning. Since the radiologist reports on these X-rays in the Accident Department and is in possession of the patient's case-notes, he is aware of the Casualty Officer's diagnosis when he comes to issue the report. If it transpires that the Casualty Officer made a significant diagnostic error, the radiologist has the responsibility to inform the referring doctor of this without further delay; likewise if in the follow-up of the case, the accident or orthopaedic staff disagrees with the radiologist's report, this is brought up for discussion to the joint weekly conference or earlier. One would prefer the radiologist to report these X-rays immediately; unfortunately, owing to staffing it is not possible and consequently reporting in retrospect has to be accepted for the time being.

It is hoped that when the staffing position permits, these daily

reporting sessions will be undertaken as a joint review of the radiographs by both the radiologist and the accident service officers. The staff of both departments would benefit from such a team effort.

We also have an arrangement to cover emergencies; we encourage Casualty Officers to come to the X-ray Department and discuss urgent cases and it is always possible to obtain the opinion of an experienced radiologist when the clinician is in doubt. Outside normal working hours, there is always a radiologist on call should he be needed.

Finally, once a week, a conference is held between the staff of the Orthopaedic/Accident and Radiology Departments, when cases of interest are presented and discussed.

Such overlap and team work between the two specialties help the training of the junior staff, raise the interest of both disciplines and, one hopes, increase the clinical and radiological acumen of the respective members. It is also hoped that the patient benefits in that fewer misdiagnoses are made.

The large majority of patients attending the Accident Department have relatively minor injuries which are usually dealt with by the Casualty Officer on duty. The severer injuries are usually referred to a more senior member of the team; patients with severe injuries are admitted and as a result the radiographs of these patients are examined and reported routinely by a radiologist. It is not intended to discuss the use of contrast media examinations, because such examinations require the presence and involvement of the radiologist. It would be reasonable to assume that the Accident and Emergency Department would be better served if there were always a diagnostic radiologist available; but as Craig (1976) pointed out, this would entail resident radiological cover as many of these emergencies occur at night and at the weekends. Such a cover cannot be met on account of the acute shortage of radiologists and this recruitment problem still persists.

It is not being suggested that the radiologist is infallible; the radiologist also makes mistakes, but one hopes these mistakes in radiological interpretation are fewer. The number of errors is bound to be considerably reduced by the fact that radiographs are inspected independently by the Accident Officer and the Radiologist, i.e. 'double reporting'. This would appear to be an important step considering the increasing litigation and the increase in the number of claims against Doctors and Hospital Authorities and the effect of the inflation on the sums awarded by the Courts. Every effort should be made to reduce the number of diagnostic mistakes. Galasko and Monahan (1971) estimated that in a busy Accident Department like the Radcliffe Infirmary, Oxford, about 1 per cent of the fractures were missed by the Casualty Officer on duty.

From our records a higher rate of errors occur in our hospital;

the number of misdiagnoses is nearer 4 per cent, there is also a tendency for certain mistakes to recur. It is difficult to estimate accurately the number of wrong interpretations of accident radiographs but it is certainly more than 1 per cent; in several samples we carried out in our department it averaged 3.8 per cent. The rate of errors appears to be related to the experience and seniority of the medical staff, to the extent of supervision of the junior doctor and to the closeness of liaison that exists between the clinical staff and the radiologist. These errors fall into two main groups:

(a) Over-diagnosis – bone or joint trauma read where none exists. This is often due to inadequate knowledge of radiographic anatomy.

(b) Misdiagnosis – bone or tissue injury is demonstrated on the radiograph, but is not seen or appreciated; or else the radiographic appearances suggested an abnormality and called for further views to confirm.

Obvious fractures are not included in this study; but it is hoped to demonstrate most of the less obvious injuries that can cause difficulty and to include the commonest pitfalls encountered. Representative radiographs are selected and grouped in chapters to cover the whole body. The aim is to suggest to the junior doctor, seeking assistance, guidelines to help him decide whether a fracture, joint injury or other damage is present or not; and, if still in doubt, what other radiographic measures should be taken.

From this study it appears that most mistakes in the radiological diagnosis are due to one of the following:

(a) Defective radiographic techniques or poor quality radiographs, or making the wrong request.

(b) Inexperience of the doctor especially with lesions which are peculiar to special regions and which need careful scrutiny.

(c) Sometimes, mis-reading of overlapping anatomical shadows or artefacts.

(d) Inadequate anatomical and radiological knowledge.

## 1.1 A CODE OF PRACTICE REGARDING THE USE OF X-RAYS IN THE ACCIDENT DEPARTMENT

### 1.1.1 Concerning the doctor requesting the X-ray

Radiography has become a necessary aid in diagnosis. It should be remembered, however, that excessive exposure to radiation can be harmful. The Casualty Officer, or, for that matter, any referring doctor, should be aware of the following information which is based on the *Code of Practice for the Protection of Persons against Ionising Radiations arising from Medical and Dental Use* (1972). When used properly, the advantages of radiography far outweigh the disadvantages and potential harm-



ful effects of the ionizing radiation.

Most of us are aware of instances where radiography, which is requested, cannot contribute anything towards the patient's diagnosis. Recently, an X-ray examination of the forearm was requested for 'bone involvement following an insect bite' which happened 4 hrs earlier. There is, of course, very little that the radiographer can do once the medical practitioner requested radiographic examination, especially if the radiologist is not in the department; if the radiologist is available, he should discuss such requests with the doctor concerned. It may not be long before litigation will arise from a patient or parents who claim assault or unnecessary damage on such a patient from the X-rays; it will be an interesting legal problem; who is responsible – the doctor who requested the examination, the radiographer who carried it out, or the employing Health Authority? The responsibility must rest on the referring doctor.

Every effort must be made to avoid especially irradiating an early pregnancy. This principle is at the back of the '10-day rule', which states that the abdominal area of a female of reproductive capacity should not be irradiated outside the first 10 days of the menstrual cycle. This ensures that no early pregnancy is exposed to X-rays. Such examinations include the abdomen, the lumbar spine, sacrum and coccyx, pelvis and hips. Obviously this recommendation does not apply to emergency cases and therefore may not be of relevance in this discussion, but perhaps it is opportune to remind ourselves that if any X-ray examination of the abdominal area in such a patient is required, which is not urgent and can easily wait to fit in with this rule, then it is the responsibility of the referring doctor to see that such a ruling is observed. If the Casualty Officer is unhappy or uncertain about a particular case the radiologist should be consulted.

Communication between the casualty doctor and radiographer should be as close and as detailed as possible, and in the absence of the radiologist, the doctor should ascertain that the radiographs are adequate and conclusive. Ideally, in the absence of the radiologist, the doctor should inspect the radiographs before the patient leaves the X-ray department, but this is not often practicable.

It should be possible to transfer radiographs with the patient from one hospital to another in order to reduce the need for unnecessary repeat exposures.

#### **1.1.2 Concerning the radiographer and X-ray equipment**

The radiographer responsible for casualty radiography should be reminded that all X-rays should be taken with the minimum necessary exposure. When X-raying patients the following points must be observed:

- (a) Cone down as much as possible to limit the field size to the