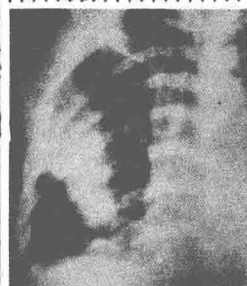
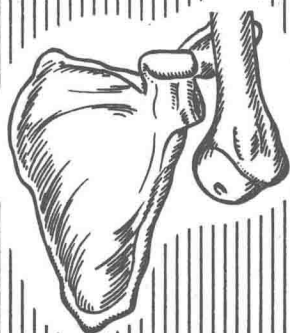


THE  
ROENTGEN  
DIAGNOSIS  
OF  
TRAUMA

H. R. ZATZKIN

# ROENTGEN DIAGNOSIS OF TRAUMA



YEAR BOOK MEDICAL PUBLISHERS • INC.

35 EAST WACKER DRIVE • CHICAGO

© COPYRIGHT 1965 BY YEAR BOOK MEDICAL PUBLISHERS, INC.

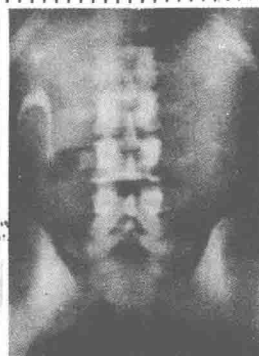
Library of Congress Catalog Card Number: 65-17377

PRINTED IN U.S.A.

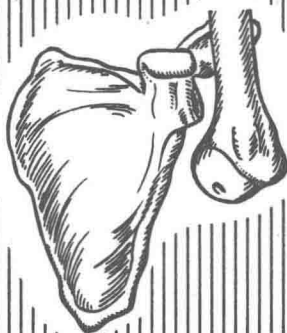
THE  
ROENTGEN  
DIAGNOSIS  
OF  
TRAUMA

HERBERT R. ZATZKIN, M.D., F.A.C.R.

*Chairman, Department of Radiology, Meadowbrook Hospital,  
the Nassau County Public General Hospital, East Meadow, Long Island, New York  
Consultant Radiologist, Community Hospital, Glen Cove, New York  
Consultant Radiologist, Hempstead General Hospital, Hempstead, New York  
Consultant Radiologist to the Office of the Medical Examiner, Nassau County, New York*



# THE ROENTGEN DIAGNOSIS OF TRAUMA



YEAR BOOK MEDICAL PUBLISHERS • INC.

35 EAST WACKER DRIVE • CHICAGO

© COPYRIGHT 1965 BY YEAR BOOK MEDICAL PUBLISHERS, INC.

Library of Congress Catalog Card Number: 65-17377

PRINTED IN U.S.A.

# Foreword

X-RAYS HAVE BEEN USED since the year of their discovery to search for and to document the extent and the nature of bodily injury. Despite energetic safety campaigns, accidents of all sorts continue to flood the emergency units of clinics and hospitals with patients for whom radiologic examination is a very important, if not the first, service to be rendered.

Drawing extensively and effectively upon his broad background of experience and the large film files of the institution he serves, Dr. Zatzkin has brought together an imposing array of illustrations which record commonplace as well as seldom encountered traumatic lesions. Diagrams have been used effectively to explain and to classify the mechanisms and the results of injury.

The publishers have welded the author's carefully collected and selected material into an atlas of fine quality, which is certain to become very useful as a reference work to all radiologists and industrial and traumatic surgeons.

The preceptor is proud of his student.

FRED JENNER HODGES

*Chairman, Department of Radiology  
University Hospital  
Ann Arbor, Michigan*





## Preface

DESPITE THE SECURE NICHE of the roentgen study in the evaluation of the "injured," it is difficult to understand the meager attention afforded traumatic roentgenology in academic circles. Surgical periodicals and texts dealing with this subject describe the latest in surgical fashions and discuss at great length altered body chemistry, physiologic imbalances and wound healing. Unfortunately, the roentgen examination as a diagnostic tool in trauma has, in my opinion, not been presented with the emphasis it deserves. In reviewing literature in preparation for the writing of this book, I have at times been appalled by the offhanded acknowledgment given to the fact that the x-ray examination is "sometimes" helpful in conditions when, in my opinion, its role was paramount to the making of the diagnosis. Since it is a rare center today which does not have available to its staff a competent radiologic service, I would assume that at times a competitive spirit between the clinician, surgeon and radiologist has developed whereby clinical judgment and sensitivity of the examining finger are pitted against the roentgen evidence of disease. It would seem that the roentgenogram is viewed with hostility by some of those whom it would purport to serve, and to some young physicians it represents a threat to their diagnostic acumen. To be sure, the radiologist cannot be held blameless for this state of affairs, where it exists. Interest in the esoteric and devotion to the newer gadgetry in radiology in some quarters have resulted in the trauma case being relegated to the province of the most junior man in the "residential hierarchy." When his interpretations are sketchy and when those aspects which are of concern to the surgeon are not fully described, of necessity the roentgen report receives but cursory attention.

Most comprehensive textbooks of radiology devote but minimal space to the subject of trauma, and students must be directed to other sources for their information. I have found this to be a serious roadblock in the training of radiology residents. Discussions of roentgen findings in rupture of the spleen and liver are to be found in surgical texts and, similarly, injuries to the kidney, bladder, facial bones, etc., are each discussed by specialists in these fields in texts not specifically oriented to the roentgen examination.

Accordingly, the preparation of this book was undertaken in an attempt to gather under a single jacket the most frequently encountered traumatic entities which the resident and practicing radiologist might be called upon to interpret. By keeping the general discussion to a minimum, deleting references to therapy and stressing roentgen diagnostic criteria and pitfalls, I have endeavored to make the work of greater usefulness to the interested physician.

It was not my intent to review the world literature or to provide a detailed annotated tome. Rather, the orientation has been to furnish a handy reference book geared to the level of the resident physician or clinician whose work brings him into contact with cases of trauma. Specialists in the various fields covered in this work will find little that is new and revolutionary, since my effort has been to emphasize, organize and, where possible, bring to bear what experience I have had in each matter under discussion. I am indebted to the many authors whose texts were used, and I have listed their works for further reference.

Of necessity, much material had to be omitted, and no claim to comprehensive coverage of any topic is made. In deciding which subjects to include, I have been influenced by my own experience with trauma at a busy County Hospital (Meadowbrook Hospital, the Nassau County Public General Hospital, East Meadow, L. I., N. Y.). This institution serves a population of one and a half million persons and is so situated as to receive accident cases from some 10 major arterial highways. Commuter traffic between suburbia and New York City, holiday traffic leading to the many beach resorts on Long Island's famous shores, industrial and construction activities all contribute their share of accidents and make Meadowbrook Hospital one of the busiest trauma hospitals in the country. Except for the several dozen roentgenograms kindly provided by interested colleagues and acknowledged herein, the illustrations come from the trauma file of this hospital.

A word of thanks is offered to those whose encouragement and assistance made this work possible. I am especially indebted to Dr. Fred J. Hodges, upon whose experience and wisdom I have leaned heavily. His recommendations and painstaking analysis of the many roentgenograms comprising this book have been of inestimable value. I am also personally obligated to Dr. Otho C. Hudson, Director of Orthopedics at Meadowbrook Hospital, for his comments permitting attention to be focused upon those aspects of fracture diagnosis of interest to orthopedic surgeons.

I am particularly grateful to Mr. Percy Brooks of Cornell Medical Center for his outstanding photographic skill, to Mrs. Angela B. Mailer for her artistic creations from my crude drawings and to Year Book Medical Publishers for their advice and co-operation.

This preface would be incomplete without acknowledgment of the assistance rendered by the technical, secretarial and library staff of Meadowbrook Hospital. Mention must also be made of the efforts of Dr. Mark Kenyon, Executive Director of the Nassau County Medical Society in providing essential background and statistical data. To the many physicians who were kind enough to contribute roentgenograms, and to the radiology resident staff for their enthusiasm in ferretting out examples of trauma from the departmental files, I offer my heartfelt thanks.

HERBERT R. ZATZKIN

# Table of Contents

Introduction . . . . .	15
<b>1. The Roentgen Signs of Trauma . . . . .</b>	<b>18</b>
Bone . . . . .	19
Fractures . . . . .	19
Bone Atrophy . . . . .	20
Bone Infarction . . . . .	21
Aseptic Necrosis . . . . .	22
Bone Infection . . . . .	23
Trophic Bone Defects . . . . .	24
Radiation Injury of Bone . . . . .	26
Traumatic Bone Cysts and Localized Osteolysis . . . . .	26
Altered Bone Growth . . . . .	26
Joints . . . . .	27
Contusion and Hemarthrosis . . . . .	27
Subluxations and Dislocations . . . . .	27
Chronic Joint Injury . . . . .	27
Neurotrophic Joints . . . . .	28
Loose Bodies in Joints . . . . .	28
Gas Shadows within a Joint . . . . .	30
Traumatic Arthritis . . . . .	30
Septic Arthritis . . . . .	31
Soft Tissues . . . . .	31
Soft Tissue Swelling . . . . .	32
Gas in Soft Tissues . . . . .	33
Calcification of Soft Tissues . . . . .	33
Foreign Bodies in Soft Tissues . . . . .	35
Viscera . . . . .	35
Perforation of a Hollow Viscera . . . . .	36
Visceral Herniation . . . . .	36
Rupture of a Solid Viscera . . . . .	36
Visceral Displacement . . . . .	37
Altered Function . . . . .	37
Heart and Vessels . . . . .	37
Post-Traumatic Vasoconstriction . . . . .	37

## 10 THE ROENTGEN DIAGNOSIS OF TRAUMA

Post-Traumatic Vasodilatation . . . . .	38
Arterial Injury . . . . .	38
Venous Injury . . . . .	38
Thromboses . . . . .	38
Aneurysm . . . . .	39
<b>2. Injuries to the Head.</b> . . . .	<b>41</b>
Cranial Vault . . . . .	41
Interpretation of the Routine Roentgenogram of the Skull . . . .	42
Soft Tissue Injuries . . . . .	43
Fractures of the Skull . . . . .	45
Sequelae of Head Trauma (with and without Fracture) . . . .	60
Penetrating Head Wounds . . . . .	65
The Facial Bones . . . . .	70
Nasal Bone Fractures . . . . .	72
Facial Bone Fractures . . . . .	74
Orbital Injury . . . . .	91
Fractures and Dislocations of the Mandible . . . . .	93
Foreign Bodies . . . . .	100
<b>3. Injuries to the Neck.</b> . . . .	<b>107</b>
Soft Tissues in General . . . . .	107
Soft Tissue Densities . . . . .	107
Radiolucent Zones . . . . .	109
Calcifications . . . . .	110
Bony Structures . . . . .	111
The Larynx . . . . .	113
Fracture of the Larynx, including the Hyoid Bone . . . . .	113
External Ventricular Laryngocele . . . . .	115
The Pharynx . . . . .	115
Retropharyngeal Hematoma . . . . .	115
Foreign Bodies (in the Throat) . . . . .	117
The Cervical Spine . . . . .	123
Anomalous Development . . . . .	125
The Whiplash Injury . . . . .	128
Subluxations and Dislocations of Cervical Spine . . . . .	137
Fractures of the Cervical Spine . . . . .	139
<b>4. Injuries of the Thoracic Cage</b> . . . . .	<b>144</b>
Ribs . . . . .	146
Clavicle . . . . .	150
Scapula . . . . .	152

Sternum . . . . .	156
Soft Tissues . . . . .	160
<b>5. Injuries to the Intrathoracic Contents . . . . .</b>	<b>162</b>
Lungs and Pleura . . . . .	163
Chemical Pneumonitis . . . . .	163
Submersion . . . . .	165
Radiation Injury . . . . .	166
Contusion of the Lung (Traumatic Pneumonitis) . . . . .	168
Pneumothorax . . . . .	170
Post-Traumatic Herniation of the Lung . . . . .	172
Fat Emboli . . . . .	172
Torsion of the Lung . . . . .	172
Gunshot Wounds (Extracardiac) . . . . .	173
Stab Wounds (Extracardiac) . . . . .	174
The Mediastinum . . . . .	178
Mediastinal Emphysema . . . . .	178
Mediastinal Hematoma . . . . .	178
Rupture of the Trachea and Bronchus . . . . .	180
Tracheobronchial Foreign Bodies . . . . .	182
Esophageal Foreign Bodies . . . . .	186
Traumatic Chylothorax . . . . .	187
The Esophagus . . . . .	188
The Heart and Great Vessels . . . . .	190
The Diaphragm . . . . .	195
<b>6. Injury to the Abdomen . . . . .</b>	<b>199</b>
Injury to the Abdominal Wall . . . . .	201
Injury to Hollow Viscera . . . . .	201
The Stomach . . . . .	201
Small Intestine Injury and Retroperitoneal Perforation of the Duodenum . . . . .	203
The Colon and Anorectal Region . . . . .	206
The Gallbladder and Extrahepatic Biliary Ducts . . . . .	209
Intra-alimentary Foreign Bodies . . . . .	210
Injury to Solid Viscera . . . . .	214
The Spleen . . . . .	214
The Liver . . . . .	217
The Pancreas . . . . .	219
The Intra-abdominal Vasculature . . . . .	221
The Retroperitoneum . . . . .	222

## 12 THE ROENTGEN DIAGNOSIS OF TRAUMA

<b>7. Injuries to the Genitourinary Tract</b>	227
Kidney	228
Ureter	231
Urinary Bladder	232
Urethra	236
The External Genitalia	239
<b>8. Injury to the Spine and Pelvis</b>	241
Traumatic Low Back Pain	241
Intervertebral Disk Injury	244
Vertebral Slipping	246
Epiphysitis of the Spine	249
Fractures of the Dorsal and Lumbosacral Spine	250
Compression Fractures	250
Tetanus	253
Hyperextension Fractures	254
Fracture-Dislocations	254
Fractures of Appendicular Structures	256
Fractures of the Sacrum and Coccyx	257
The Pelvis	258
Fractures and Dislocations	258
Gunshot Wounds of the Spine and Pelvis	266
<b>9. Dislocations of Peripheral Joints and Epiphyseal Injuries</b>	268
Dislocations of the Lower Extremity	268
The Hip	268
The Knee	272
The Patella	273
The Ankle	274
The Joints of the Foot	280
Dislocations of the Upper Extremity	285
The Shoulder	285
The Elbow	293
The Wrist and Hand	297
Epiphyseal Injuries	302
Upper Femoral Epiphysis	302
Injuries of Other Epiphyses	304
<b>10. Fractures of the Lower Extremity</b>	312
Thigh	312
The Proximal Thigh (Hip)	312
The Midthigh (Femoral Shaft)	317

The Distal Thigh . . . . .	317
The Patella . . . . .	317
The Leg . . . . .	324
The Proximal Leg . . . . .	324
The Midshaft of the Leg . . . . .	334
The Lower Leg (Malleolar Fractures) . . . . .	336
The Foot . . . . .	336
The Calcaneus . . . . .	336
The Navicular . . . . .	338
The Astragalus . . . . .	339
The Cuboid and Cuneiform Bones . . . . .	340
The Metatarsals . . . . .	340
The Phalanges . . . . .	343
<b>11. Fractures of the Upper Extremity . . . . .</b>	<b>344</b>
The Humerus . . . . .	344
The Proximal Humerus . . . . .	344
The Humeral Shaft . . . . .	348
The Distal Humerus . . . . .	348
Forearm . . . . .	352
The Head of the Radius . . . . .	352
The Olecranon . . . . .	355
The Midforearm . . . . .	355
Wrist . . . . .	358
Hand . . . . .	363
The Carpal Bones . . . . .	363
The Metacarpals . . . . .	368
The Phalanges . . . . .	369
<b>12. Fracture Complications . . . . .</b>	<b>372</b>
The Mangled Extremity . . . . .	372
Fracture Healing . . . . .	374
Infection . . . . .	377
Pathologic Fractures . . . . .	381
Fractures of the Previously Traumatized Limb . . . . .	384
<b>13. Trauma Associated with Athletics and Sports . . . . .</b>	<b>385</b>
Regional Injuries Common to Several Sports . . . . .	386
Injuries Associated with Individual Sports . . . . .	387
Baseball . . . . .	387
Football . . . . .	391
Basketball . . . . .	396



<b>14</b>	<b>THE ROENTGEN DIAGNOSIS OF TRAUMA</b>	
	Wrestling and Gymnastics . . . . .	399
	Track and Field Events . . . . .	399
	Soccer . . . . .	399
	Ice Hockey . . . . .	402
	Golf . . . . .	402
	Skiing . . . . .	403
	Water Skiing . . . . .	404
	Boxing . . . . .	405
	Tennis . . . . .	406
	Skin and Scuba Diving . . . . .	406
	Dancing . . . . .	408
<b>14.</b>	<b>Miscellaneous Injuries</b> . . . . .	<b>409</b>
	Accidental Injuries . . . . .	409
	Injury in the Aerospace and Missile Industry . . . . .	409
	The Seat Belt Syndrome . . . . .	410
	Lawn Mower Injuries . . . . .	411
	Fireworks and Blast Injuries . . . . .	412
	The Home Workshop Injury . . . . .	415
	Fishing Injuries . . . . .	415
	The Battered Child Syndrome . . . . .	417
	Miscellaneous Foreign Bodies Embedded in Soft Tissues . . . . .	419
	Iatrogenic Trauma . . . . .	423
	Radiology and the Work of the Medical Examiner . . . . .	425
	Ballistics . . . . .	428
	Roentgen Study in Cases of Homicide . . . . .	431
	Identification by Roentgen Means . . . . .	433
	Index . . . . .	439