

Justice Through Radiology Forensic Radiology

www.jahshan.club

www.jahshan.expert

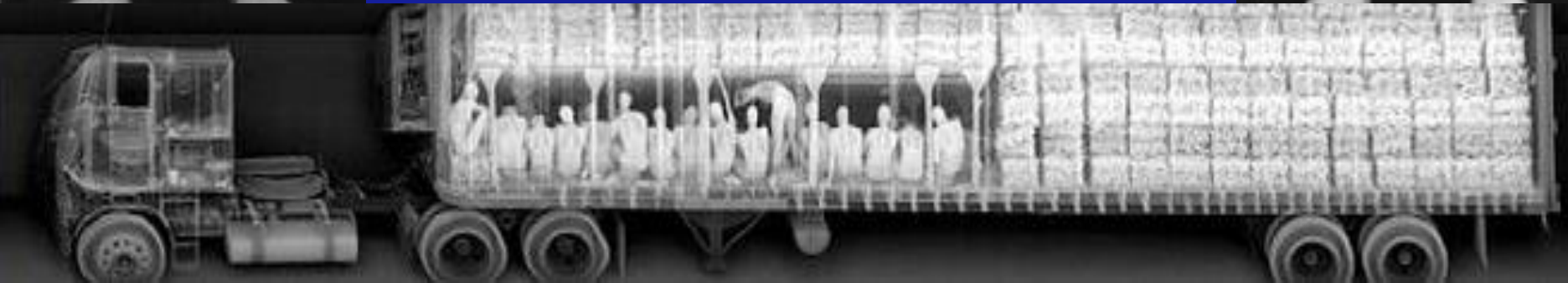
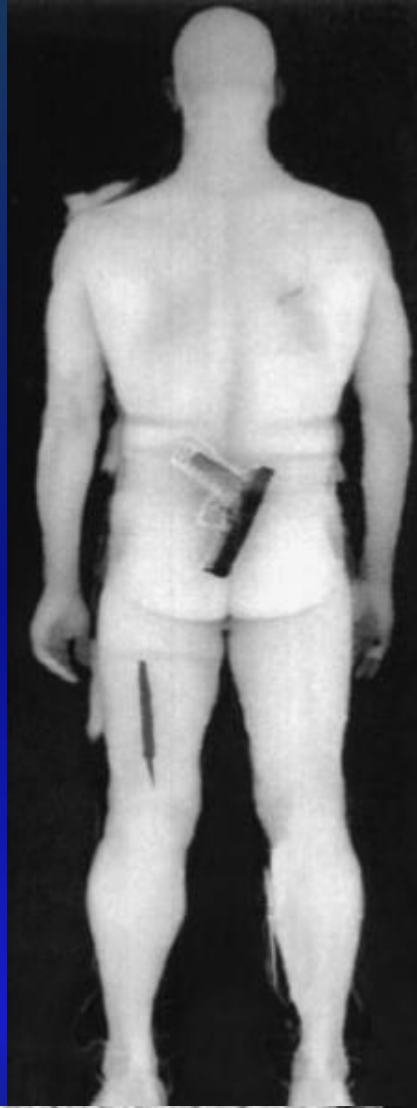
Hani Jahshan, MD

Senior Forensic Medicine Consultant

BDF Hospital

2017/4/4

The goal of this Presentations is to cover the entire scope of radiological applications in the forensic sciences.



Part 1 “this Presentation”

- 1) Introduction
- 2) Documentation of Injury
- 3) Documentation of Drug Abuse
- 4) Documentation of Self Induced Injuries
- 5) Documentation of Foreign Bodies
- 6) Sudden Unexpected Infant Death
- 7) Bullets of Firearm Injuries
- 8) Non-accidental Injury
- 9) Condition that may mimic child abuse

Part 2

Bombings and Explosions
Body Packing

Part 3

Identification

Part 4

Terror Prevention
Borders Control

Part 5

Age Estimation

Part 6

Virtual Autopsy

Introduction 1

- 1) Imaging techniques are powerful tools in forensic sciences.
- 2) The "evidence" admissible to court is based on interpretation of findings rather than the image itself.
- 3) Forensic Sciences is a Team Work, Forensic pathologists, Anthropologists, Odonatologist, Biologists, Entomologists etc.... Radiologist,

Introduction2

- 1) **Locating of foreign bodies** within the body (i.e., bullets, gas emboli),
- 2) **Documentation** of fractures, and other mechanical injuries.
- 3) **Identification of unknown human remains** in common in most forensic facilities throughout big cities in the world
- 4) **Mass disaster identification:** Radiology application in mass disasters are very efficient, swift, and relatively easy.
- 5) **Age estimation...**
- 6) **Virtual autopsy (Virtopsy)...**


Giovanni Morgagni

An Italian anatomist, the
father of modern anatomical
pathology, 1682-1771



Taceant colloquia. Effugiat risus. Hic locus
est ubi mors gaudet succurrere vitae.

"Let conversation cease, let laughter flee. This is
the place where death delights to help the living"



"LET CONVERSATION
CEASE. LET LAUGHTER
FLEE. THIS IS THE PLACE
WHERE DEATH DELIGHTS
TO HELP THE LIVING"

Pilgrim Psychiatric Center, formerly known as Pilgrim State Hospital. Built:1930 Opened:1941
in 1954 it had 13,875 patients

"Let conversation cease, let laughter flee. This is the place where death delights to help the living"

Henry C. Lee

O.J. Simpson case



Forensic Science is used to predict not the future but the past.

X-rays are a “Black Box” of human being

Definition

Forensic: is derived from the Latin forens(is): of or belonging to the **forum**, By extension it came to also mean **disputative**, **argumentative**, belonging to debate or discussion.

Modern Definition of Forensic: pertaining to, connected with, or used in courts of judicature or public discussion and debate.

Forensic Sciences: encompass the application of specialized scientific and/or technical knowledge to questions of civil and criminal law, especially in court proceedings.

Forensic Chemistry, Forensic Toxicology, Forensic Biology
Forensic Medicine, Forensic Pathology, etc.

>>>>> Forensic Radiology ?

Medicolegal Domains:

- 1) Homicide
- 2) Suicide
- 3) Accident
- 4) Hazardous substance
- 5) Death in custody
- 6) Medical malpractice
- 7) Unattended by a physician
- 8) Sudden or suspicious.
- 9) Mass disasters
- 10) Missing persons
- 11) Human trafficking
- 12) Drug trafficking
- 13) Terrorism
- 14) Hunger strike
- 15) Torture
- 16) Forensic anthropology
- 17) Violence (child, elder, woman, disabled...)
- 18) Civil unrest
- 19) War crimes
- 20) Corruption in health sector
- 21) Organ transplantation
- 22) Medical ethics
- 23) Public Health violence prevention
- 24) Health legislations

>>>>> **Forensic Radiology ?**

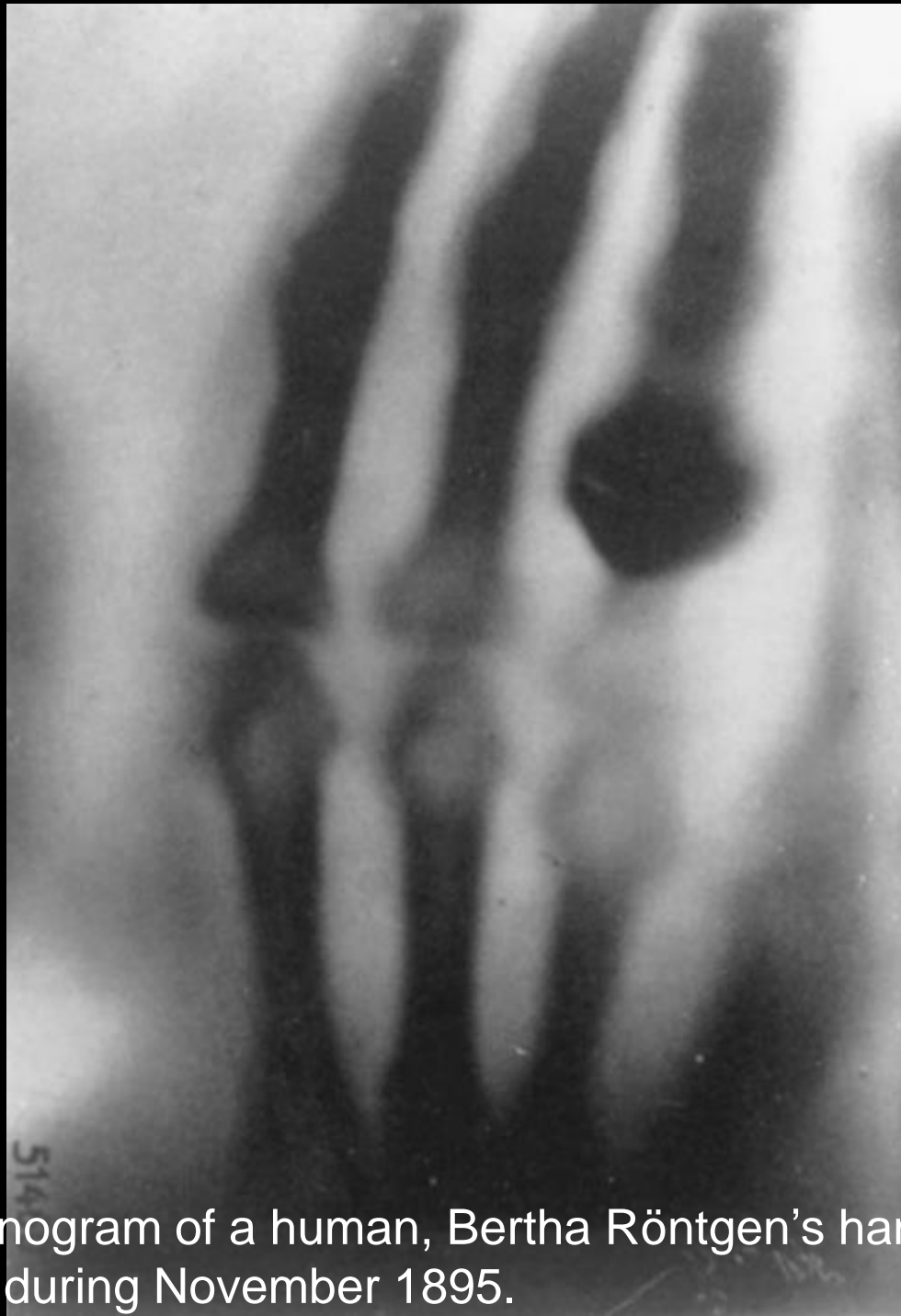
History



Wilhelm Conrad Röntgen, German/Dutch mechanical engineer and physicist
Bertha Röntgen, nee Ludwig. Nov. 1895 – Announces X-ray discovery
1901 Receives first Nobel Prize in Physics

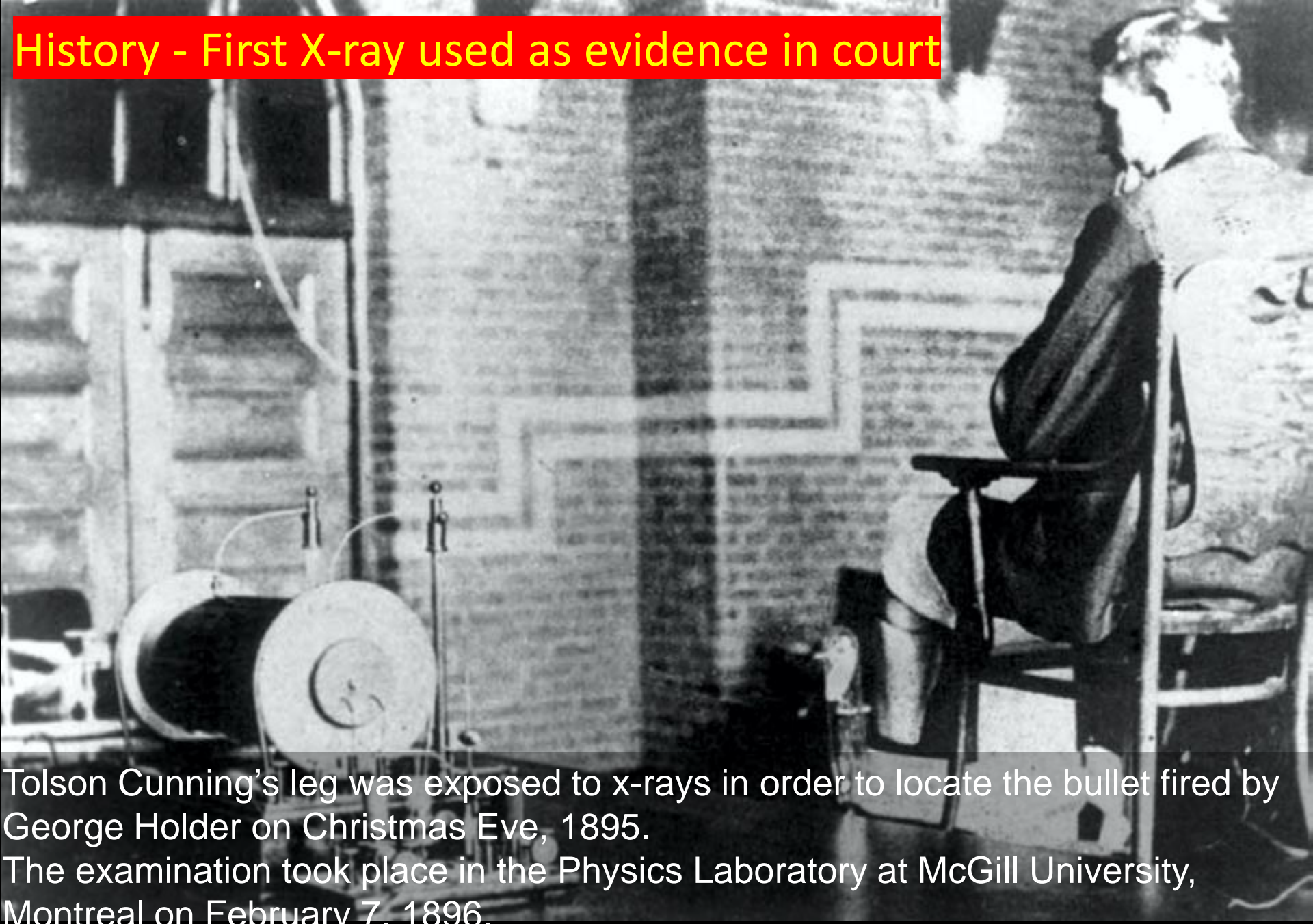
W. C. Röntgen

History



The first roentgenogram of a human, Bertha Röntgen's hand, exposed in the laboratory during November 1895.

History - First X-ray used as evidence in court



Tolson Cunning's leg was exposed to x-rays in order to locate the bullet fired by George Holder on Christmas Eve, 1895.

The examination took place in the Physics Laboratory at McGill University, Montreal on February 7, 1896.

The result was the first x-ray plate to be admitted to a court.





The right side of Kennedy's head, showing brain matter.
Damage is quite extensive, more than is indicated by some of the earlier theories.

Definition

Forensic Radiology is the portion of science that deals with the relation and application of medical imaging facts to legal problems.

Reasons for the absence Forensic Radiology Services:

1. Forensic pathologist does imaging themselves and feel comfortable being alone.
2. Imaging facilities or engagement of a radiologist is too expensive.
3. Radiologists are:
 1. too busy
 2. uninterested in forensic issues
 3. It is not a priority to them
 4. wary of involvement in legal matters
 5. vague subject to them
- Medicolegal services is a team work.
- Failure to build a team effort with an interested radiologist is a lost opportunity.

The characteristics that define forensic radiologist :

1. Inquisitiveness, keenness, interest, and curiosity.
2. Dedication to public service.
3. Integrity and objectivity.
4. willingness to testify in court.

Forensic radiology, as do all other academic and scientific disciplines, needs:

1. Providing the service
2. Continuous education
3. Research
4. Administrative arrangement.

Scope of radiological applications in Justice:

1. Determination of Identity -mass disasters – aircraft accidents
2. Evaluation of Injury and Death (Accidental, Non-accidental, Suicidal, medical conditions)
 1. Osseous injury
 2. Missiles and foreign bodies
 3. Traumatology
 4. Radiology and abuse – child – elder- domestic violence
 5. civil rights violations - torture
3. Criminal Litigation
 1. Fatal
 2. Nonfatal
4. Civil Litigation
 1. Fatal
 2. Nonfatal
5. Administrative Proceedings – age estimation
6. Radiology and Borders control
7. Radiology and high technology. Virtual Autopsy.
8. Radiology and Borders control.

Forensic Anthropology:

1. Forensic anthropology is that field of science whose major focus is the identification of more or less skeletonized remains, either human or animal, in a legal context.
2. applies the skills and techniques learned in the study of **prehistoric populations** to modern forensic cases.
3. applies the knowledge to establish the **age, sex, race** or **ancestry, stature, handedness**, and often the **manner of death** of modern skeletal remains found in a medicolegal context.

Forensic Archaeology :

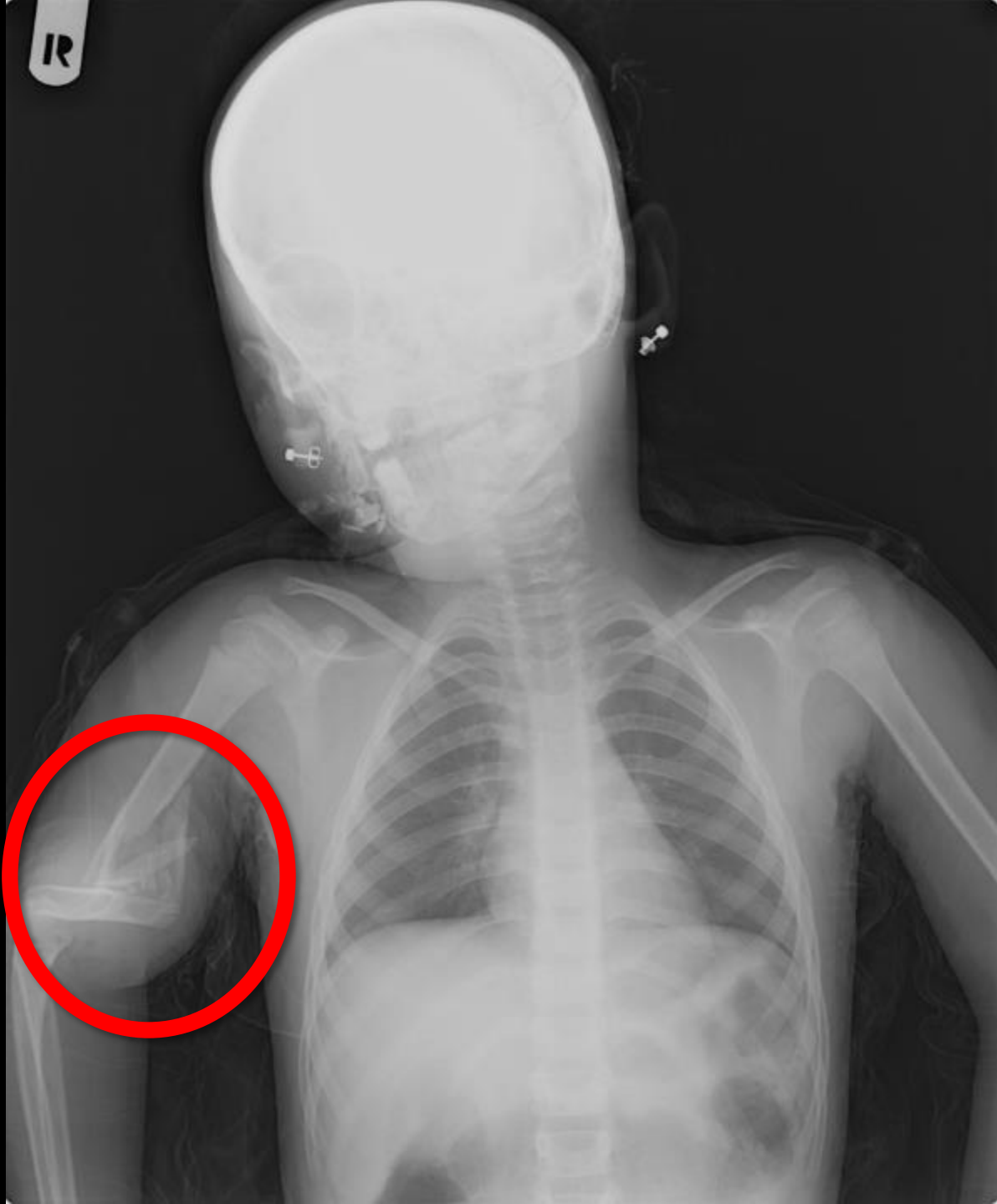
1. **Archaeology:** the study of human history and prehistory through the excavation of sites and the analysis of artifacts and other physical remains
2. **Forensic Archaeology** is application of archaeological techniques to the search and recovery of evidential material from crime scenes, related to buried human remains.

Documentation of Injury

Evaluation of Injury or Death:

1. Evaluation requires elements of detection, pattern recognition, interpretation, and comparison.
2. based on radiologic training and experience with normal and abnormal findings in patients of both sexes and all age groups.







Vehicular accident with cervical dislocation causing death. The C1 vertebra (1) is posteriorly dislocated with respect to the C2 (2) vertebra, a finding best demonstrated with a lateral film of the cervical spine, like this one.



A: typical “bumper fracture” in an adult pedestrian hit from the right. B: “bumper fracture” in a child hit from the left is higher in the leg. Because of the increased elasticity and plasticity of young bones, the impact produced an incomplete or “greenstick” fracture.

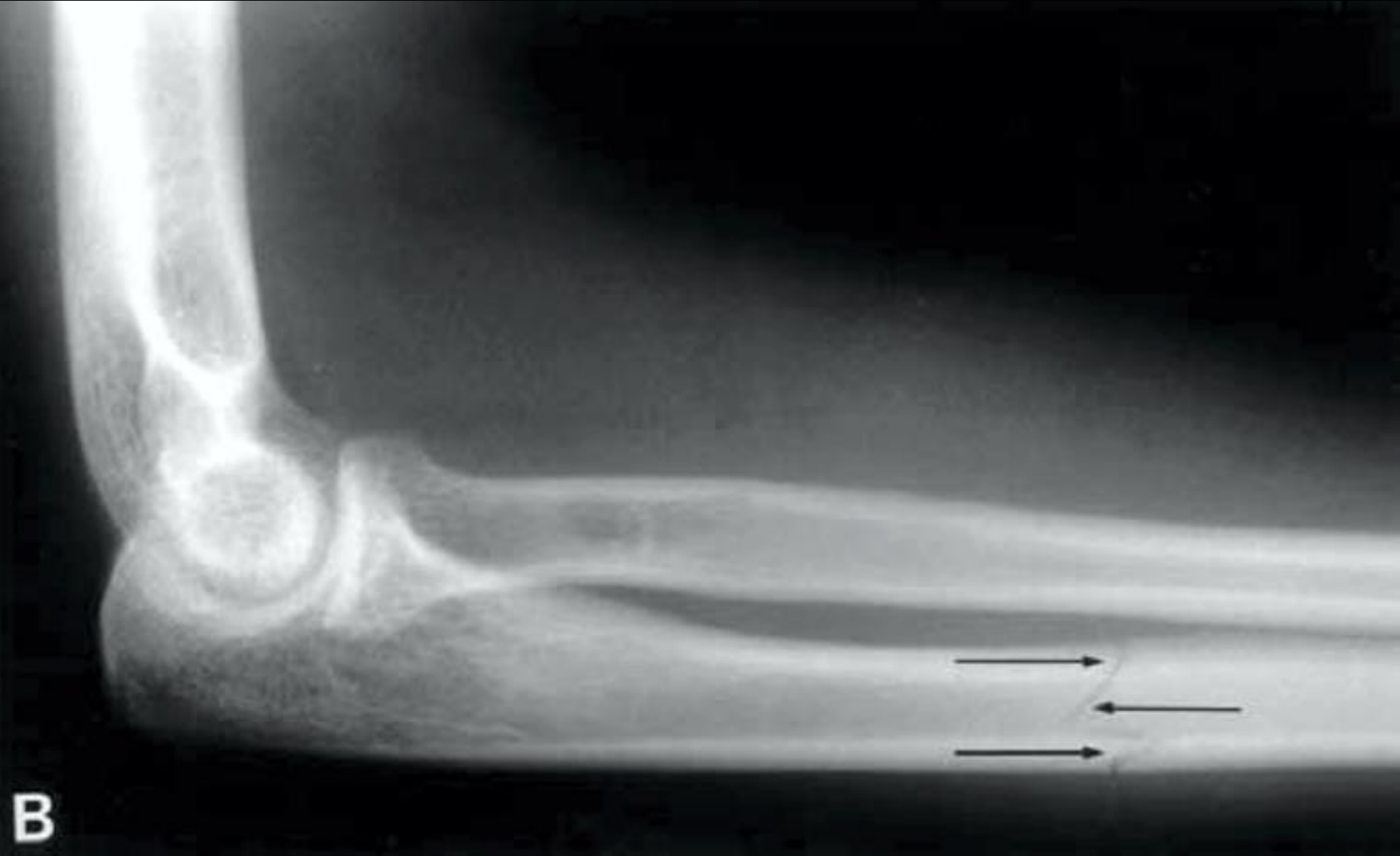


Pedestrian injury



A

A : “fending fracture” of the ulna — the result of trying to ward off a blow by blocking it with the upraised forearm. These have also been called “night-stick” or “pool-cue” fractures. B : a subtle, undisplaced fending fracture. كسر الصد كسر القنوة



A : “fending fracture” of the ulna — the result of trying to ward off a blow by blocking it with the upraised forearm. These have also been called “night-stick” or “pool-cue” fractures. B : a subtle, undisplaced fending fracture. كسر الصد كسر القنوة



A: this is a so-called “toddler’s fracture” commonly seen in young children in the early years as they begin to walk and run, but are not yet very steady or coordinated.
B: this nonambulatory infant has a similar-looking fracture, but one impossible to acquire naturally in the course of infantile movement. Rather, this fracture was caused by a twisting force or torsion at the hands of an adult caregiver



fracture of the hyoid bone (arrow) from strangulation.



fractures of the superior cornua of the thyroid cartilage from strangulation.



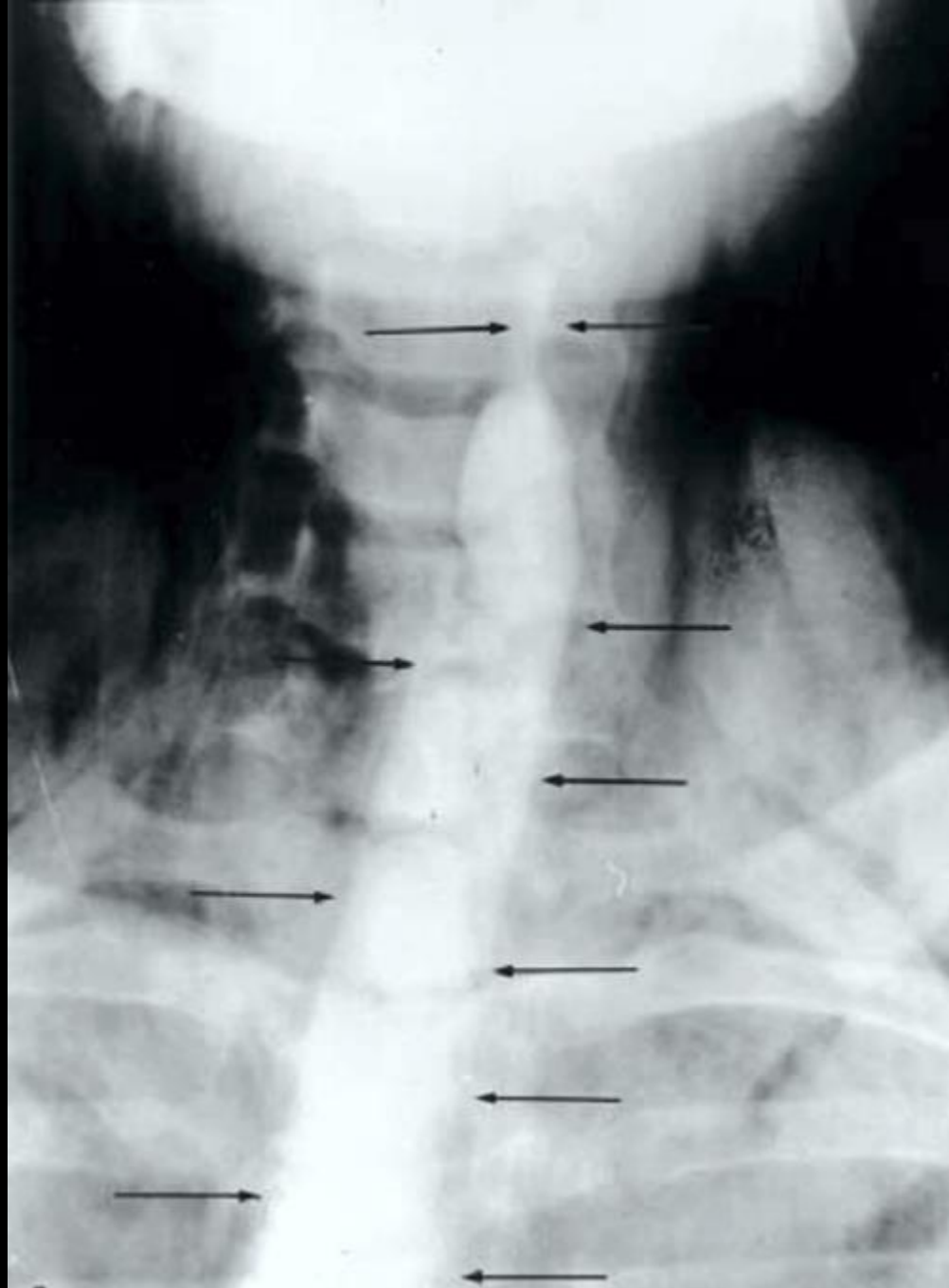
Shard of glass (arrows) from a broken beer bottle remain in the lung of this stabbing victim.



A bottle was driven into the victim's face. The cap stayed behind as the bottle was withdrawn



chopper



A sand completely packs the tracheobronchial tree of a man who drowned in high surf



man who recovered from near drowning in surf was found to have sand impactions in right lung

Documentation of Drug Abuse



Habitual, long-term Cocaine sniffing has been associated with destruction of the nasal septum rhinitis, and sinusitis

Computed tomography examination in the coronal plane of the nasal cavity and ethmoid and maxillary sinuses shows absence of the nasal septum

9

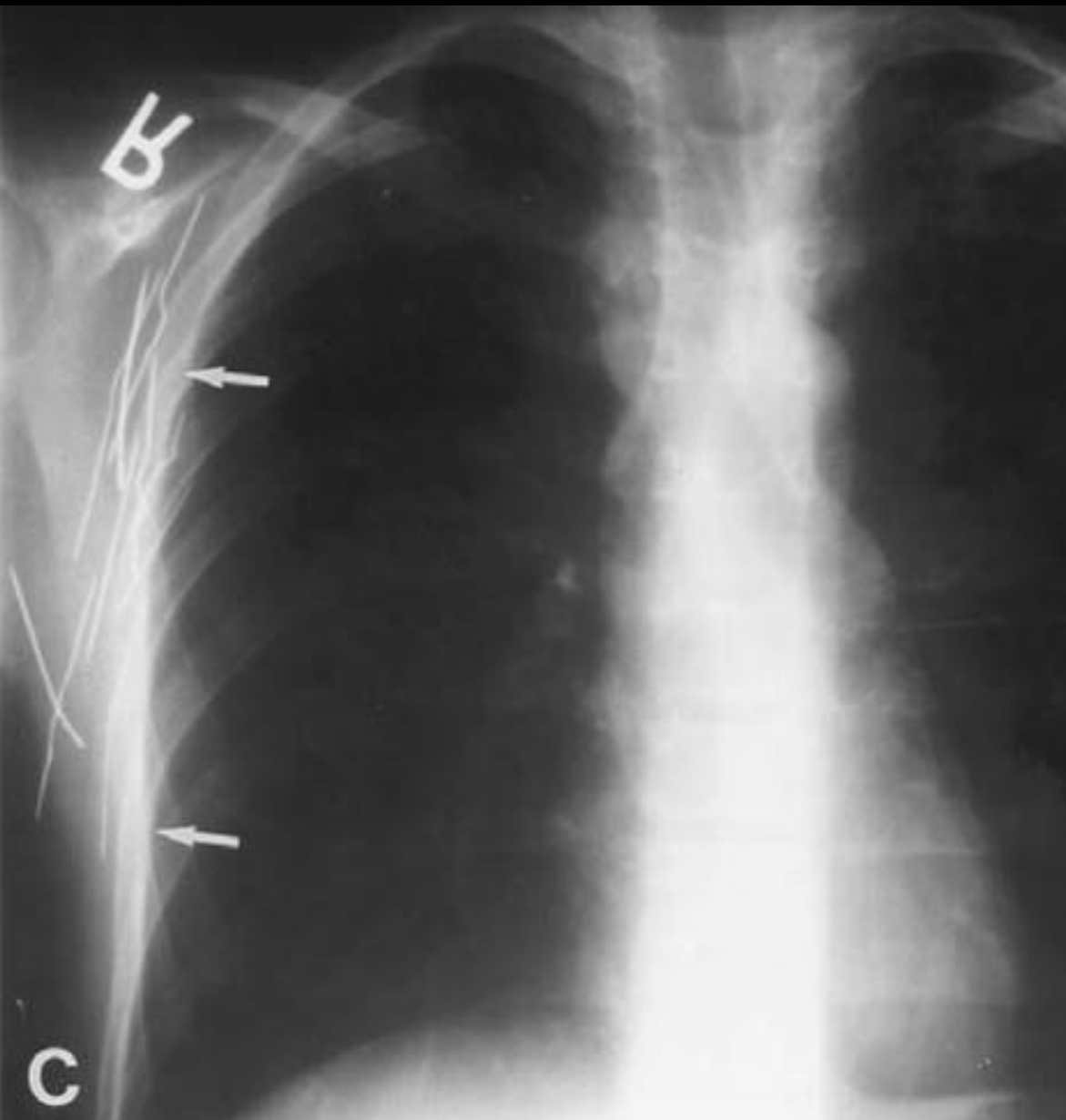


Arterial injection of heroin by error causing arterial occlusion. user erroneously injected heroin in the brachial artery with subsequent necrosis of the distal fingers



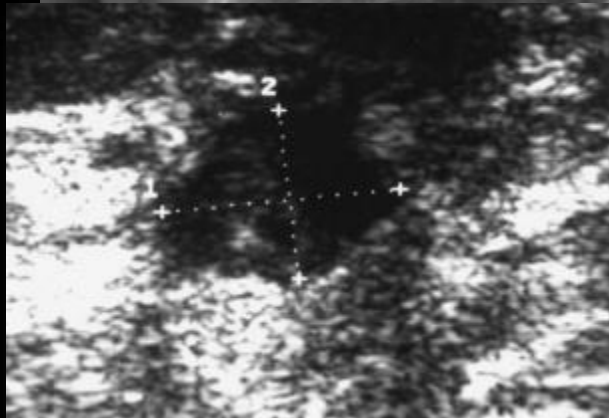
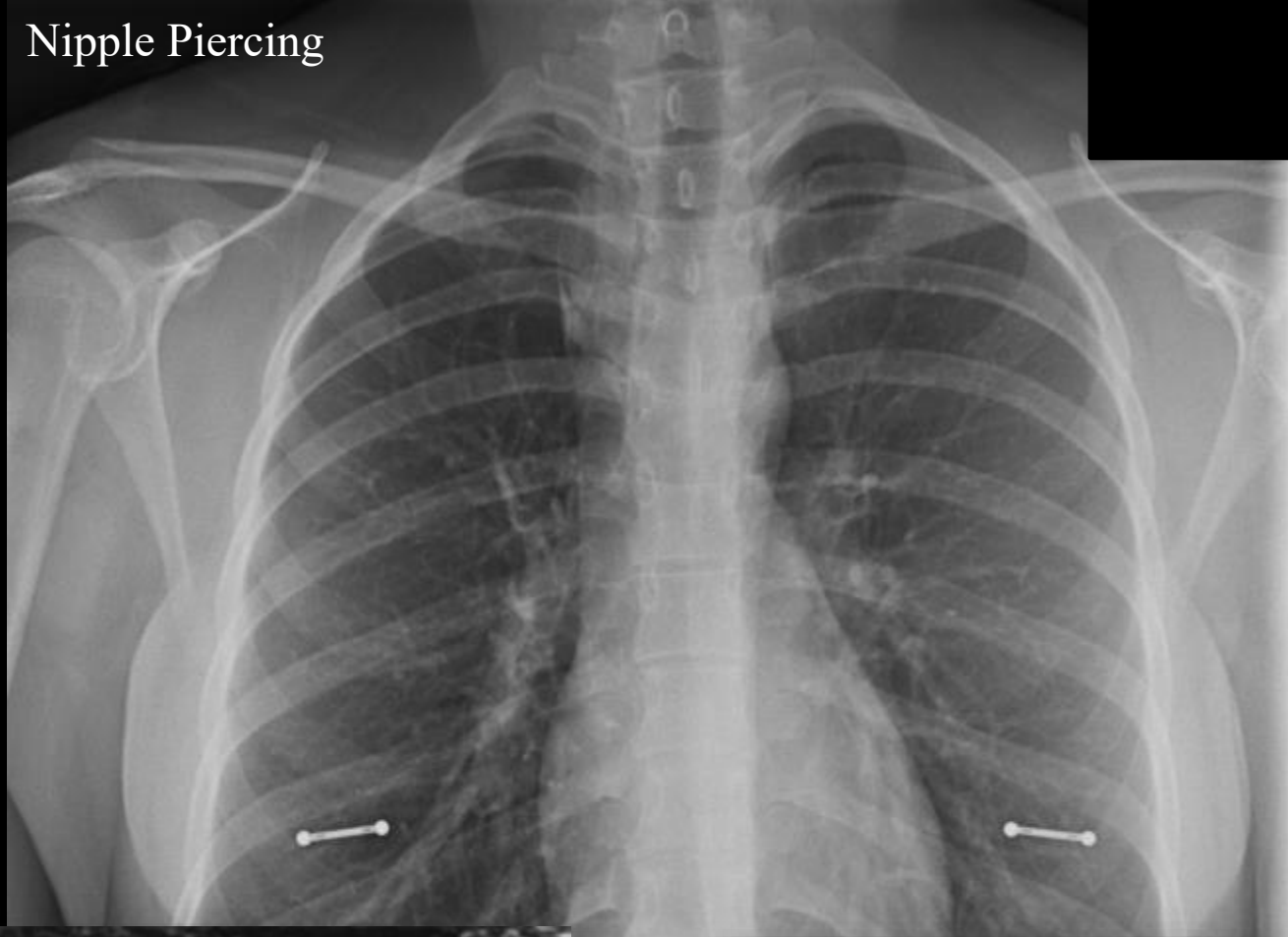
needle breakage with the fragment left inside the body

Documentation of Self Induced Injuries

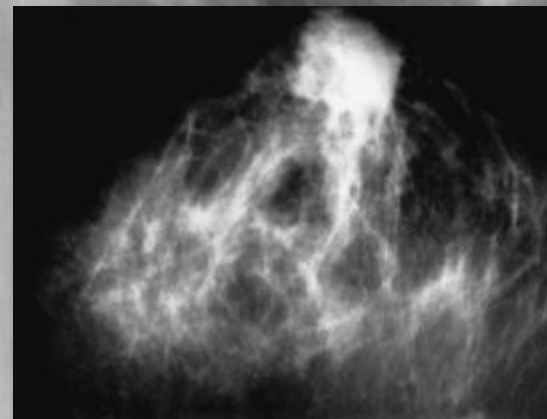


disturbed youth who obviously is left-handed inserts wires — straightened paper clips (arrows) beneath his skin. One has traveled through the venous system to the right ventricle (arrow).

Nipple Piercing



Ultrasound showing subareolar abscess



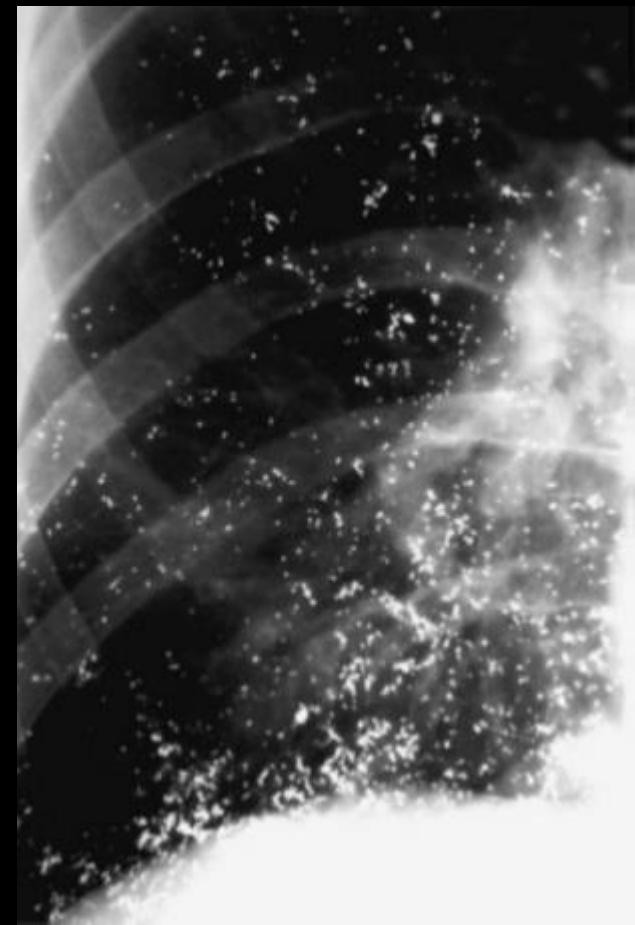
Mammogram showing abscess



TONGUE PIERCING

Tongue piercing increases the risk of infection with hepatitis and inflammatory complications during dental treatment. Injuries to the teeth can be sustained from the metallic devices.

Rings in other locations have some risk of infections. For instance, rings in the labia and clitoris may increase the risk of AIDS, hepatitis, and sexually transmitted diseases.



This nurse committed suicide by intravenous injection of liquid mercury. (A) Shows the distribution of mercury particles throughout the lungs. (B) Close-up view of the right lung

Documentation of Foreign Bodies

Foreign Bodies GI tract:

Places in the alimentary tract where foreign bodies are most likely to hang up: in order:

1. The level of the insertion of the cricopharyngeus and the esophagus
2. The esophagus where it crosses over the left main stem bronchus
3. The gastroeso-phageal junction
4. The pylorus
5. The junction of the second and third portions of the duodenum
6. The ligament of Treitz
7. The ileo-cecal valve
8. The splenic flexure and the sigmoid flexure



needle breakage with the fragment left inside the body



his woman on furlough from a mental institution trailed her husband through a hardware store as if she were at a cafeteria,





water glass in the rectum



B

plastic vibrator lost in the rectum



can of hair spray.



This thief rolled his wad of paper money in plastic wrap and deposited it in his rectum for safekeeping.



wrench



87 2 9

insulated wires threaded through the penis and the bladder where they are coiled so that they cannot be withdrawn

Sudden Unexpected Infant Death

Classification of Sudden Unexpected Infant Death (SUID)

- Sudden infant death syndrome (SIDS) is one of several causes of SUID, but it is the most frequently reported. It is a diagnosis of exclusion, through a careful case investigation, which includes a thorough examination of the death scene, a complete autopsy, and a review of the infant's medical records. SIDS currently accounts (50%) of SUID yields.
- **Unknown Cause:** The sudden death of an infant less than 1 year of age that cannot be explained because a thorough investigation was not conducted and cause of death could not be determined. (26%)
- **Sleep-related infant deaths:** accidental suffocation and strangulation in Bed. Suffocation by soft bedding such as a pillow or waterbed mattress. Overlay when another person rolls on top of or against the infant while sleeping. Wedging or entrapment when an infant is wedged between two objects such as a mattress and wall, bed frame, or furniture. Strangulation such as when an infant's head and neck become caught between crib railings. (18%)
- In approximately (10%-20%) of cases of SUID a specific cause of death is identified
 - **Accidental** versus **Neglect** (hyperthermia, hypothermia, carbon monoxide poisoning, drowning...) 3%
 - **Homicide:** Infanticide and intentional suffocation (1%-4%)
 - **Natural Diseases:** Infections 5%. Congenital anomalies 7%. Metabolic disorders 1%

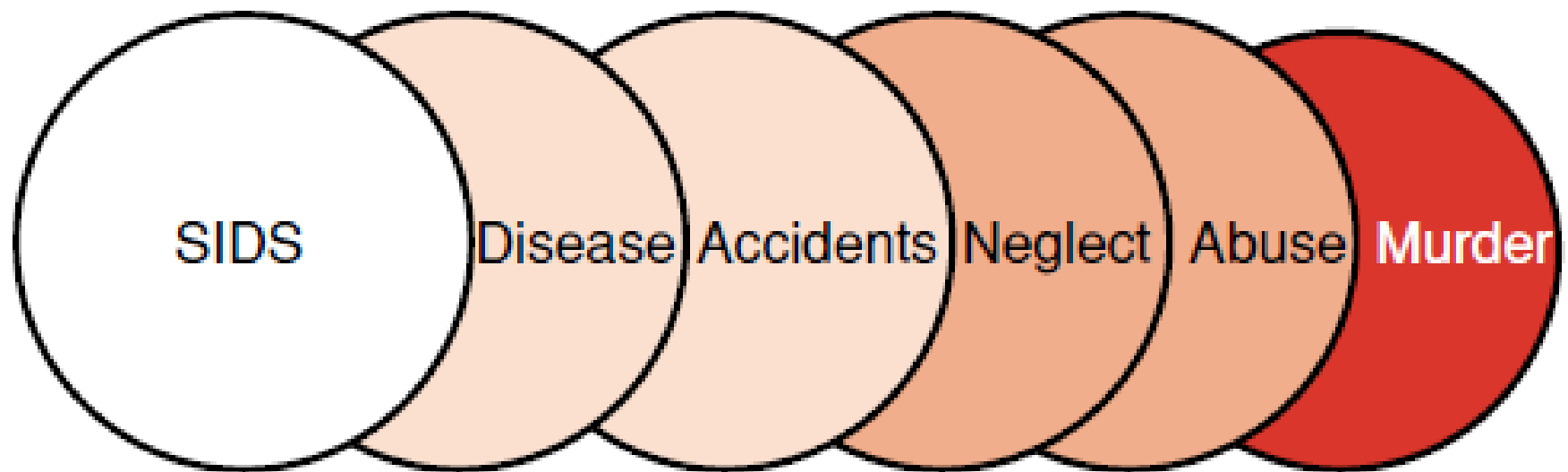


Figure 8 The diagnosis of SIDS is difficult due to lack of positive criteria and potential overlap of findings.

SUID Investigation

Homicide

Metabolic disorders

Natural causes

Premature low birth weight

Suffocation

SIDS

Sudden Infant Death Syndrome

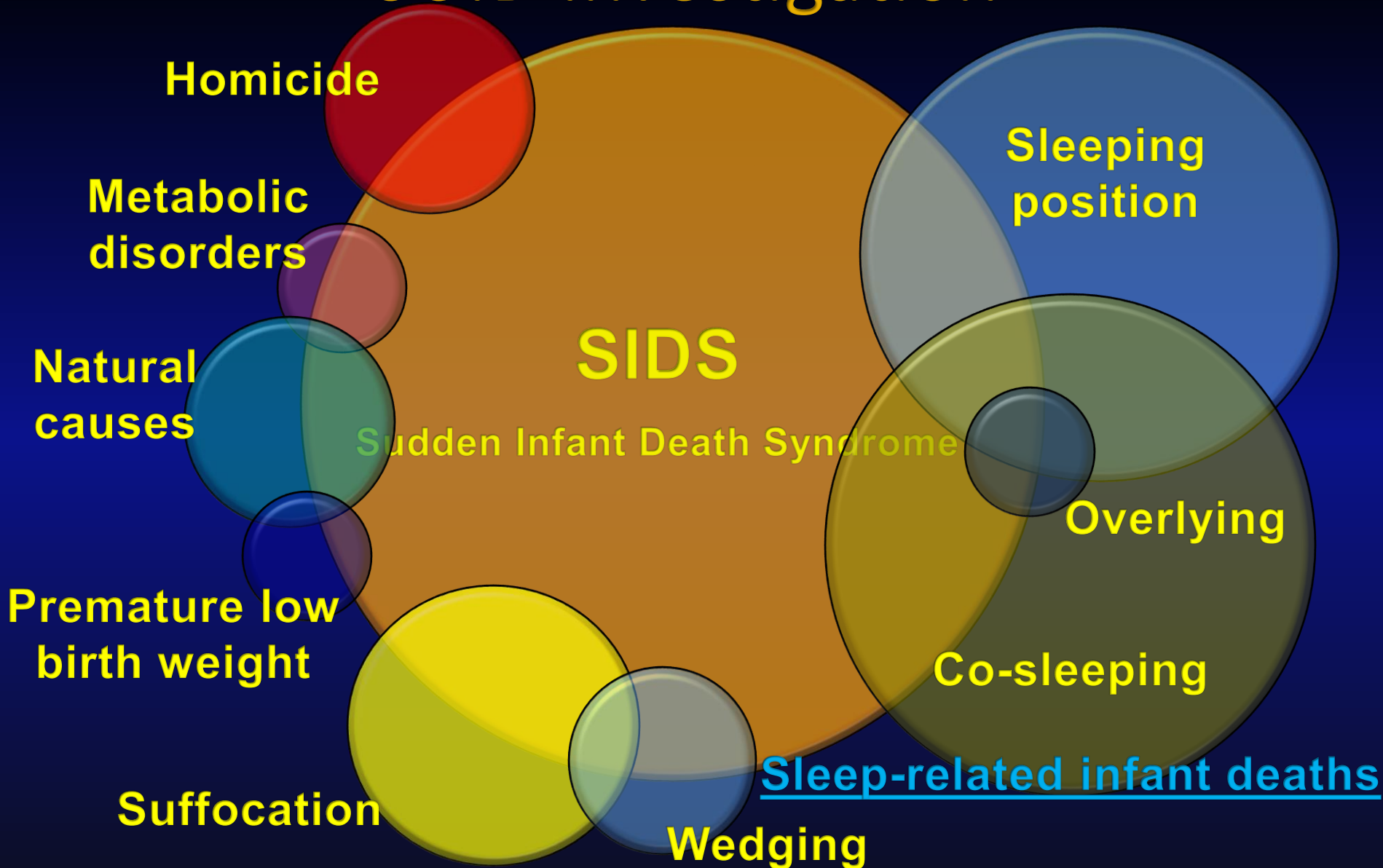
Sleeping position

Overlying

Co-sleeping

Sleep-related infant deaths

Wedging



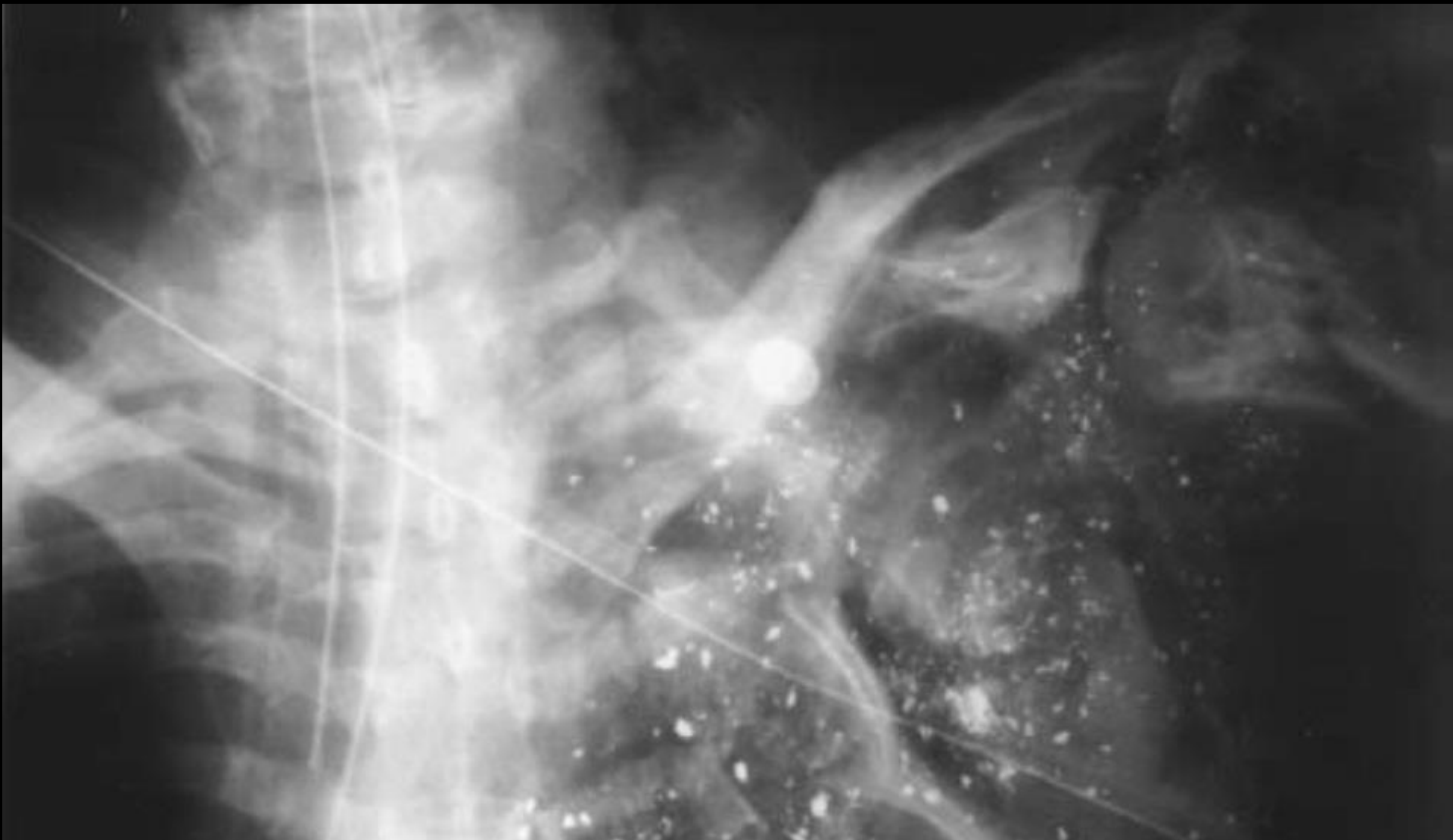
Sudden Infant Death Syndrome

- 1) A full skeletal survey is performed before the autopsy.
- 2) A verbal report is obtained from the reporting radiologist
- 3) X-rays are routine for children under 2 years of age
- 4) optional after this, depending on history, circumstances, and external examination.

Bullets of Firearm Injuries

Gunshot wound and x-ray:

1. All gunshot wound cases x-rays should be taken.
 - 1) where the bullet is known to be in the body
 - 2) in which it has allegedly exited
2. a bullet can be overlooked “professional blinkers phenomenon”
3. bullets might migrate
4. The path of the bullet can be observed as a cloud of minute metallic particles detached from the projectile, the so-called “lead snowstorm” or by CT scan.
5. The type of bullet (high or low velocity) indicate the type of weapon used.
6. Establishing the bullet’s caliber from a radiograph should be avoided because angulation and distance from the beam can distort the image.
7. metallic fragments of bullet



A high-velocity rifle wound to the chest left a typical “lead snowstorm” of fragments. The victim was accompanying her daughter who had just won a divorce. The enraged ex-husband shot and killed his ex-wife as she exited the courthouse, then killed his ex-mother in-law as she covered behind a car. (Note the spread of the “snowstorm” from superolateral to infero medial.

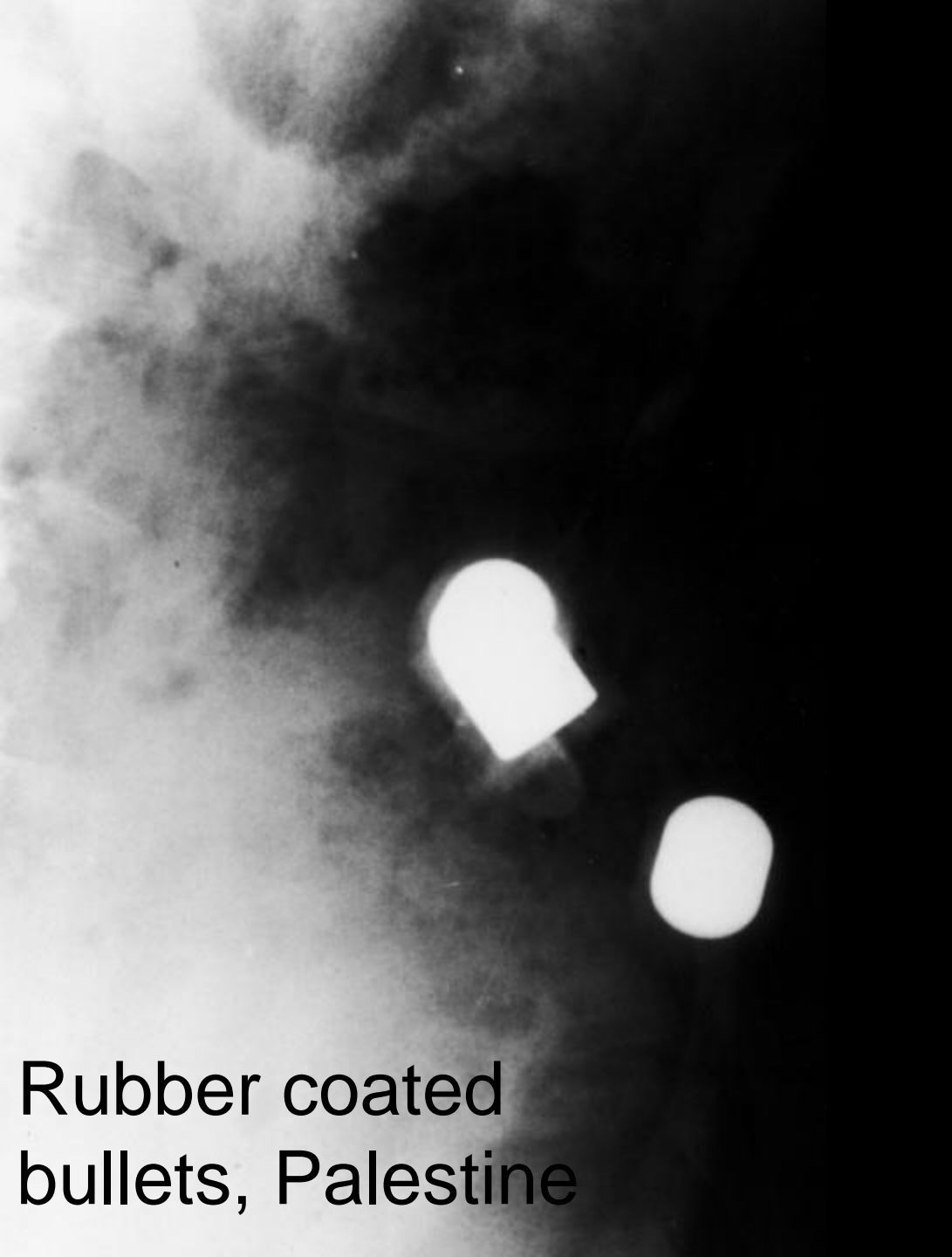


Birdshot

Birdshot

**numerous small, scattered,
superficially excavated
scars identified on the hip
of this middle-aged man
who died of natural causes.
X-ray revealed old shotgun
wound of the hip with
birdshot. The small scars
were healed pellet entrance
wounds.**





Rubber coated
bullets, Palestine



Nonaccidental Injury

Forensic Radiology in Clinical Forensic Medicine:

1. The early identification and proper management of the victims of abuse while they are still living cannot only predict, but also can modify, the future.
2. Life can be preserved, even enhanced, and necropsy can be averted

Radiology of Physical Abuse:

1. Protocols for Examination
2. Skeletal Injuries
3. Head Injuries
 - 1) Intracranial Injuries
 - 2) Shaking Injuries
4. Visceral Trauma
 - 1) Thorax
 - 2) Abdomen
5. Soft Tissues

in loco parentis

1. The term in loco parentis, Latin for "in the place of a parent" refers to the legal responsibility of a person or organization to take on some of the functions and responsibilities of a parent.
2. all adults involved in rearing or supervising the child, including teachers, trainers, masters of trainees, workhouse bosses, factory foremen, and superintendents of children's institutions.



In 1860, Ambrose Tardieu (1818-1879) was a French physician specializing in pathology, public health, and legal medicine .

A year later he would become Professor of Legal Medicine at the University of Paris, a post he held until his death. But in 1860 Tardieu published an article on the abuse and maltreatment of children; it was reprinted in a book on wounds published a year after his death

MÉDECINE LÉGALE.

ÉTUDE MÉDICO-LÉGALE

SUR LES

SÉVICES ET MAUVAIS TRAITEMENTS

EXERCÉS SUR DES ENFANTS,

Par le **D^r Ambroise TARDIEU,**

Professeur agrégé de médecine légale à la Faculté de médecine.

Parmi les faits si nombreux et de nature si diverse dont se compose l'histoire médico-légale des coups et blessures, il en est qui forment un groupe tout à fait à part, et qui, laissés jusqu'ici dans l'ombre la plus complète, méritent à plus d'un titre d'être mis en lumière. Je veux parler de ces faits qualifiés sévices et mauvais traitements, et dont les enfants sont plus particulièrement victimes de la part de leurs parents. Une fois, j'ai écrit dans un journal un mot qui exercent sur eux une

In 1860, Ambroise Tardieu (1818-1879) was a French physician specializing in pathology, public health, and legal medicine.

A year later he would become Professor of Legal Medicine at the University of Paris, a post he held until his death. But in 1860 Tardieu published an article on the abuse and maltreatment of children; it was reprinted in a book on wounds published a year after his death.

ÉTUDE MÉDICO-LÉGALE
SUR
LES BLESSURES

COMPRENANT
LES BLESSURES EN GÉNÉRAL
ET
LES BLESSURES PAR IMPRUDENCE
LES COUPS ET L'HOMICIDE INVOLONTAIRES

PAR
AMBROISE TARDIEU
Professeur de médecine légale à la Faculté de médecine de Paris.

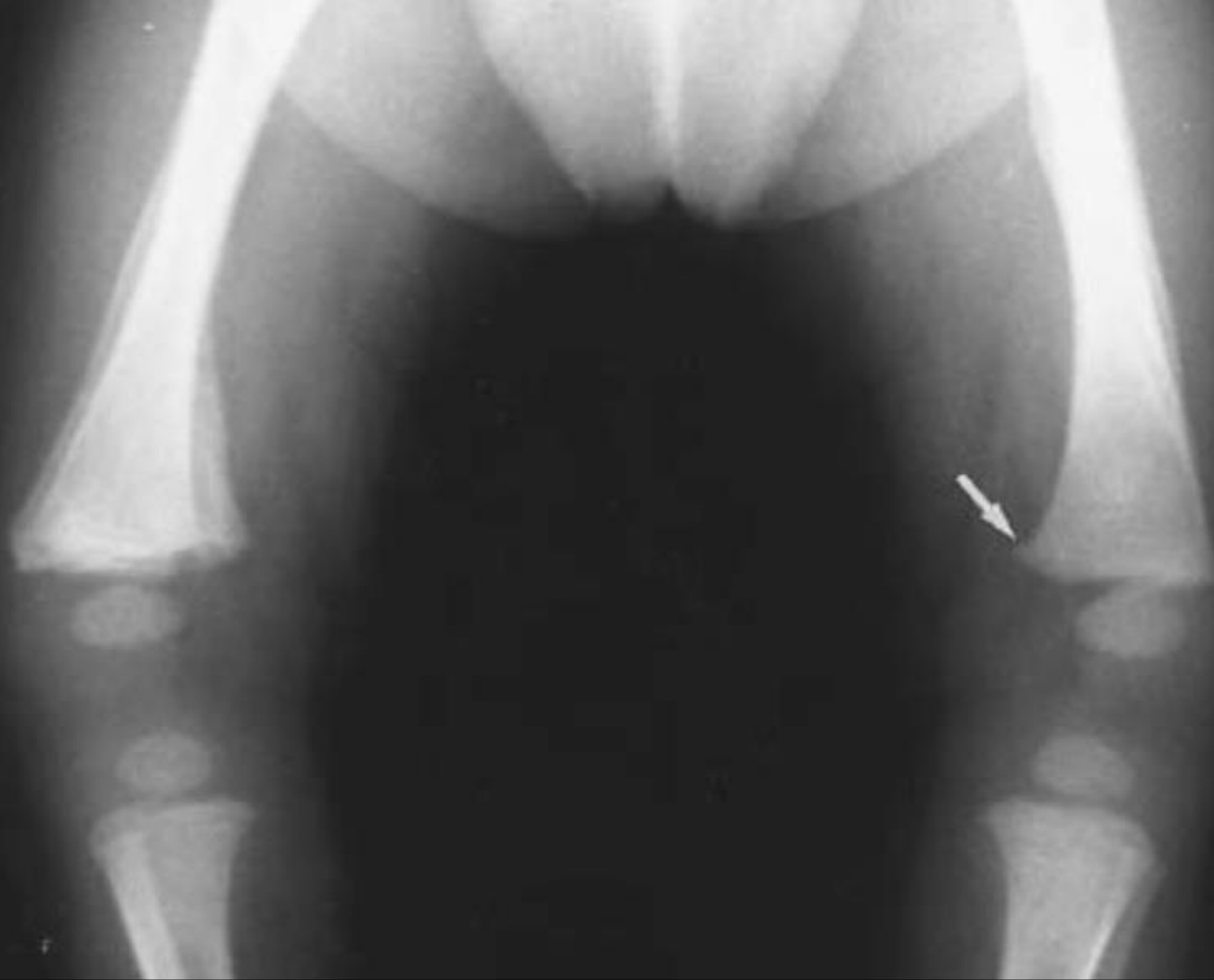


In 1860, Ambroise Tardieu (1818-1879) was a French physician specializing in pathology, public health, and legal medicine .

A year later he would become Professor of Legal Medicine at the University of Paris, a post he held until his death. But in 1860 Tardieu published an article on the abuse and maltreatment of children; it was reprinted in a book on wounds published a year after his death



A: severe bilateral metaphyseal fragmentation in the distal femora. The “corner fractures fragments” are larger than usual.
B: small “corner fracture” on left; “involucrum” on right.



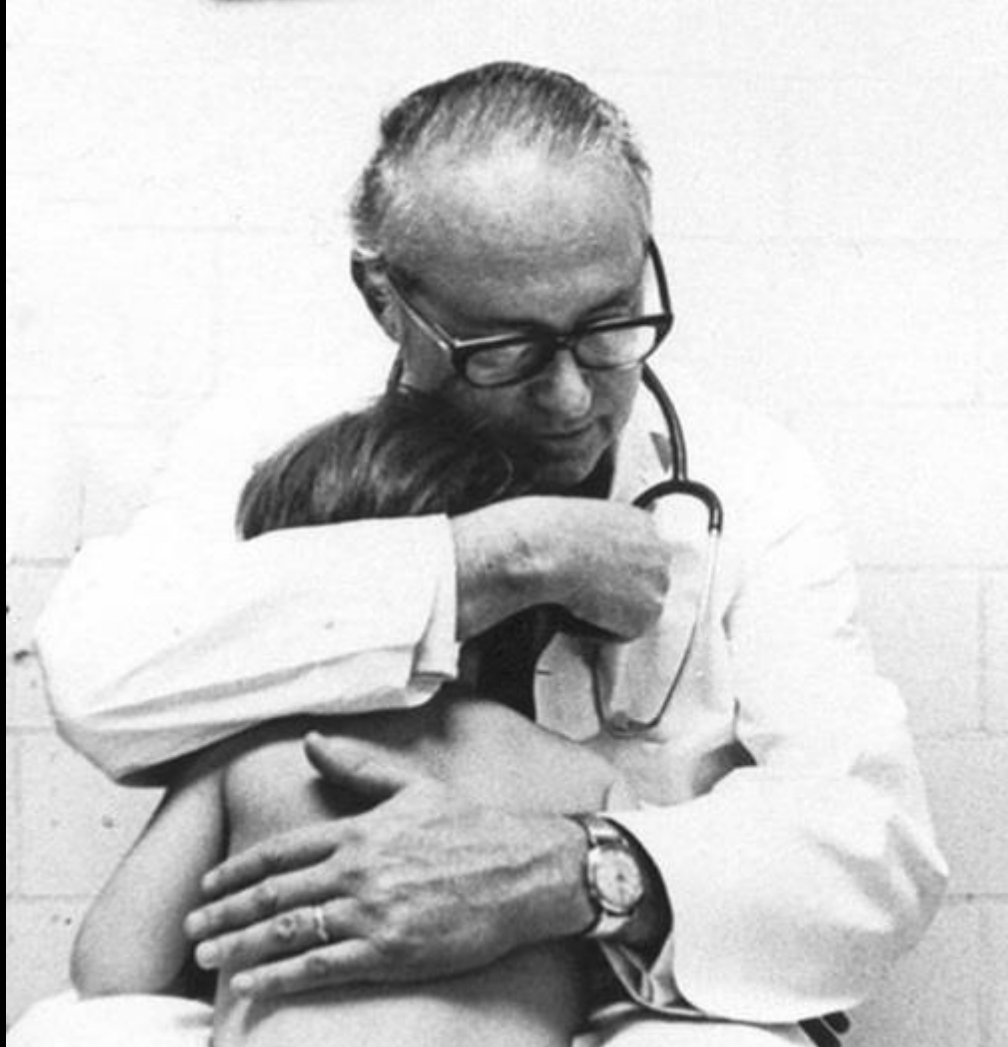
A: severe bilateral metaphyseal fragmentation in the distal femora. The “corner fracture fragments” are larger than usual.
B: small “corner fracture” on left; “involucrum” on right.



Large “involucrum” (actually a calcified subperiosteal hematoma) around the shaft of the humerus.



Caffey suggested parent infant trauma stress syndrome in 1965 offered the phrase Parental Dysfunction
“Le Syndrome de Silverman” in France,
“Le Syndrome de Caffey”,



Finally, in 1962, Kempe intentionally coined the name **Battered Child Syndrome** to attract attention to this neglected clinical and social problem. This provocative and anger producing term was successful in gaining widespread public attention. This was enhanced by a science writers forum on the subject sponsored by the **American College of Radiology in 1962**, featuring a radiologist, a pediatrician, and a distinguished jurist on the panel.



THE BATTERED-CHILD SYNDROME

C. HENRY KEMPE, M.D., DENVER, FREDERIC N. SILVERMAN, M.D.,
CINCINNATI, BRANDT F. STEELE, M.D., WILLIAM DROEGEMUELLER, M.D.,
AND HENRY K. SILVER, M.D., DENVER

Professor and Chairman (Dr. Kempe) and Professor of Pediatrics (Dr. Silver), Department of Pediatrics; Associate Professor of Psychiatry (Dr. Steele), and Assistant Resident in Obstetrics and Gynecology (Dr. Droegemueller), University of Colorado School of Medicine; and Director, Division of Roentgenology, Children's Hospital (Dr. Silverman).

Abstract—The battered-child syndrome, a clinical condition in young children who have received serious physical abuse, is a frequent cause of permanent injury or death. The syndrome should be considered in any child exhibiting evidence of fracture of any bone, subdural hematoma, failure to thrive, soft tissue swellings or skin bruising, in any child who dies suddenly, or where the degree and type of injury is at variance with the history given regarding the occurrence of the trauma. Psychiatrist but knowledge of these factors is evaluation of the problem and to

THE BATTERED-CHILD condition in young children parent or foster parent. The radiologists, orthopedists, p childhood disability and dea is inadequately handled by attention of the proper auti

In an attempt to collect a wide survey of hospitals within year period. Among 71 hospitals of the children died; and 85 medical diagnosis was folio Attorneys who reported that these, 45 died, and 29 suffer this group. This condition single day, in November, 1 caring for 4 infants suffering died of their central nervous manner 4 weeks after discharge fourth is still enjoying good

Reprinted with permission of the American Medical Association 181: 251-3288, June 22, 1984. Cq

C. H. Kempe, F. N. Silverman, B. F. Steele, W. Droegemueller and H. K. Silver
CLINICAL MANIFESTATIONS

The clinical manifestations of the battered-child syndrome vary widely from those cases in which the trauma is very mild and is often unsuspected and unrecognized, to those who exhibit the most florid evidence of injury to the soft tissues and skeleton. In the former group, the patient's signs and symptoms may be considered to have resulted from failure to thrive from some other cause or to have been produced by a metabolic disorder, an infectious process, or some other disturbance. In those patients specific findings of trauma such as trauma or characteristic roentgenographic changes as described below may be interpreted and their significance not recognized.

The battered-child syndrome may occur at any age, but, in general, the affected children are younger than 3 years. In some instances the clinical manifestations are limited to those resulting from a single episode of trauma, but more often the child's general health is below normal and there is evidence of neglect including poor skin hygiene, multiple soft tissue injuries, and malnutrition. One often obtains a history of previous episodes suggestive of parental neglect or trauma. A marked discrepancy between clinical findings and historical data as supplied by the parents is a major diagnostic feature of the battered-child syndrome. The fact that no new lesions, either of the soft tissue or of the bone, occur while the child is in the hospital or in a protected environment lends added weight to the diagnosis and tends to exclude many diseases of the skeletal or hematopoietic systems in which lesions may occur spontaneously or after minor trauma. Subdural hematomas, with or without fracture of the skull, is, in our experience, an extremely frequent finding even in the absence of fractures of the long bones. In an occasional case the parent or parent-substitute may also have assaulted the child by administering an overdose of a drug or by exposing the child to natural gas or other toxic substances. The characteristic distribution of these multiple fractures and the observation that the lesions are in different stages of healing are of additional value in making the diagnosis.

In most instances, the diagnostic bone lesions are observed incidentally to examination for purposes other than evaluation for possible abuse. Occasionally, examination following known injury discloses signs of other, unsuspected, skeletal involvement. When parental denial is under consideration, radiologic examination of the entire skeleton may provide objective confirmation. Following diagnosis, radiologic examination can document the healing of lesions and reveal the appearance of new lesions if additional trauma has been inflicted.

The radiologic manifestations of trauma to growing skeletal structures are the same whether or not there is a history of injury. Yet there is reluctance on the part of many physicians to accept the radiologic signs as indications of repetitive trauma and possible abuse. This reluctance stems from the emotional unwillingness of the physician to consider abuse as the cause of the child's difficulty and also because of unwillingness to reveal aspects of fractures leading to that he is unaware of the significance of the lesions that are present. To the informed physician, the bones tell a story the child is too young or too frightened to tell.

PSYCHIATRIC ASPECTS

Psychiatric knowledge pertaining to the problem of the battered child is meager and the behavior of the subject is almost unmeasurable. The type and degree of physical attack varies greatly. At one extreme, there is direct transfer of children. This is usually done by a parent or other close relative, and, in these individuals, a frank psychosis is usually readily apparent. At the other extreme are those cases where no overt harm has occurred, and one parent, more often the mother, comes to the psychiatric for help, filled with anxiety and guilt related to

The battered-child syndrome

145

fantasies of harming the child. Occasionally the disorder has gone beyond the point of fantasy and has reached its severe slipping or spouting. In such cases the adult is usually responsive to treatment; it is not known whether or not the disturbance in these adults would progress to the point where they would inflict significant trauma on the child.

Between these 2 extremes are a large number of battered children who with mild to severe injury which may clear completely or result in permanent damage or even death after repeated attack. Descriptions of such children have been published by numerous investigators including radiologists, orthopedists, and social workers. The latter have reported on their studies of investigations of families in which children have been beaten and of their work in effecting satisfactory placement for the protection of the child. In some of these published reports, the parents, or at least the parent who inflicted the abuse, have been found to be of low intelligence. Often, they are described as psychopathic or sociopathic characters. Alcoholism, sexual promiscuity, unstable marriage, and minor criminal activities are reportedly common amongst them. They are irascible, impulsive, self-centered, hypochondriac, and quick to react with poorly controlled aggression. Data in some cases indicate that such attacking parents had themselves been subject to some degree of attack from their parents in their own childhood.

Beating of children, however, is not confined to people with a psychopathic personality or of borderline socioeconomic status. It also occurs among people with good education and stable financial and social background. However, from the scant data that are available, it would appear that in these cases, too, there is a defect in character structure which allows aggressive impulses to be expressed too freely. There is also some suggestion that the attacking parent was subjected to similar abuse in childhood. It would appear that one of the most important factors to be found in families where parental attack occurs is "to do unto others as you have been done by." This is not surprising; it has long been recognized by psychologists and social anthropologists that patterns of child rearing, both good and bad, are passed from one generation to the next in relatively unchanged form. Psychologically, one could describe this phenomenon as an identification with the aggressive parent; this identification occurred despite strong wishes of the parent to be different. Not infrequently the beating infant is a product of an unwanted pregnancy, a pregnancy which began before marriage, too soon after marriage, or at some other time felt to be extremely inconvenient. Sometimes several children in one family have been beaten; at other times one child is singled out for attack while others are treated quite lovingly. We have also seen instances in which the sex of the child who is severely attacked is related to very specific factors in the course of the abusive parent's neurosis.

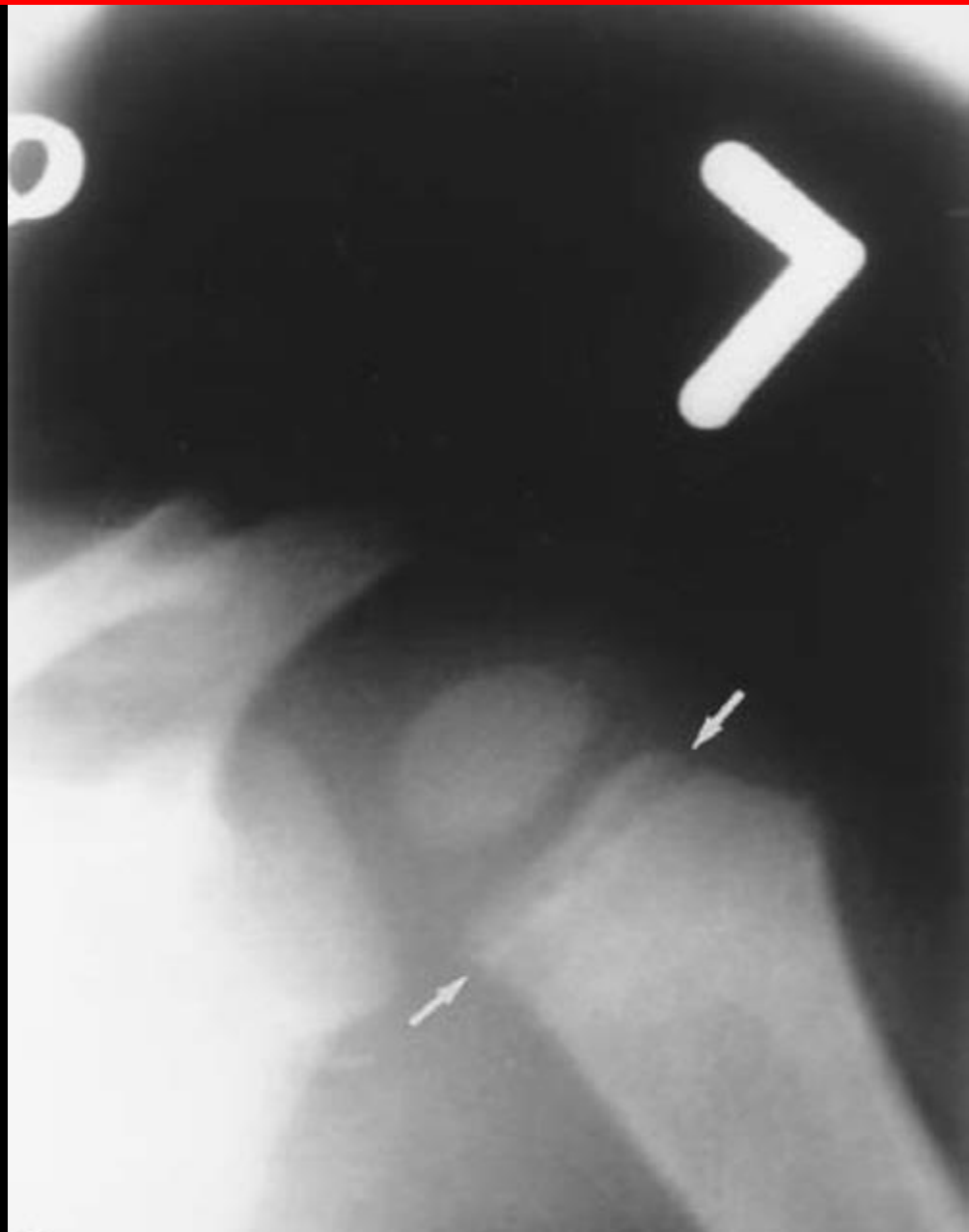
It is often difficult to obtain the information that a child has been attacked by its parent. To be sure, some of the extremely sociopathic characters will say, "Yeah, Ma'am would not stop crying to I hit him. So what? The crib handle so I hit him harder." Sometimes one spouse will indicate that the other was the attacking person, but more often there is complete denial of any knowledge of injury to the child and the maintenance of an attitude of complete innocence on the part of both parents. Such attitudes are maintained despite the fact that witnesses of physical attack is obvious and that the trauma could not have happened in any other way. Denial by the parents of any involvement in the abusive episode may, at times, be a conscious, protective device, but in other instances it may be a denial based upon psychological repression. Thus, one mother who seemed to have been the one who injured her baby had complete amnesia for the episode in which her aggression bore forth so strikingly.

In addition to the reluctance of the parents to give information regarding the attacks on their children, there is another factor which is of great importance and extreme interest to us, relates to the difficulty in deriving into the parents of parental neglect and abuse. This is the fact that physicians have great difficulty here in believing that parents could have attacked their children and in undertaking the essential questioning of parents on this subject. Many

Table 15-1 American College of Radiology Appropriateness Criteria

Radiologic Exam Procedure	Appropriateness Rating	Comments
Clinical Condition: Suspected physical abuse, child 2 yrs. or less		
Variant 1: No focal signs or symptoms		
Plain x-ray - skeletal survey	9	
Plain x-ray - skull film	9	
Ultrasound - abdomen	2	
MRI - brain	2	
CT - brain	No consensus	
Nuclear medicine - bone scan	No consensus	
Clinical Condition: Suspected physical abuse, child 2 yrs. or less		
Variant 2: Head trauma by history, no focal findings, no neurological abnormality		
Plain x-ray - skeletal survey	9	This includes two views of the skull.
CT - Brain	8	
MRI - brain	4	If necessary for added documentation.
Ultrasound - abdomen	2	
Plain x-ray - skull film	No consensus	Necessary if the two views in the skeletal survey and the CT do not show fracture.
Nuclear medicine - bone scan	No consensus	Indicated when a clinical suspicion of abuse remains high and documentation still necessary.
Clinical Condition: Suspected physical abuse, up to age 5		
Variant 3: Neurological signs and symptoms, with or without physical findings		
Plain x-ray - skeletal survey	9	This includes two views of the skull.
CT - Cranial without contrast	9	
Ultrasound - Cranial	2	
CT - Cranial with contrast	2	
Plain x-ray - skull film	No consensus	Necessary if the two views in the skeletal survey and the CT do not show fracture.
Nuclear medicine - bone scan	No consensus	Indicated when a clinical suspicion of abuse remains high and documentation still necessary.
MRI - brain	No consensus	If the CT is normal and documentation is necessary to prove abuse.
Clinical Condition: Any age child, visceral injuries, discrepancy with history		
Variant 4: Physical and laboratory examinations inconclusive		
Plain x-ray - skeletal survey	9	
CT - CECT abdomen + pelvis	9	
Ultrasound - abdomen + pelvis	2	
MRI - abdomen + pelvis	2	
CT - abdomen + pelvis	2	
CT - cranial with or without contrast	2	
MRI - cranial	2	

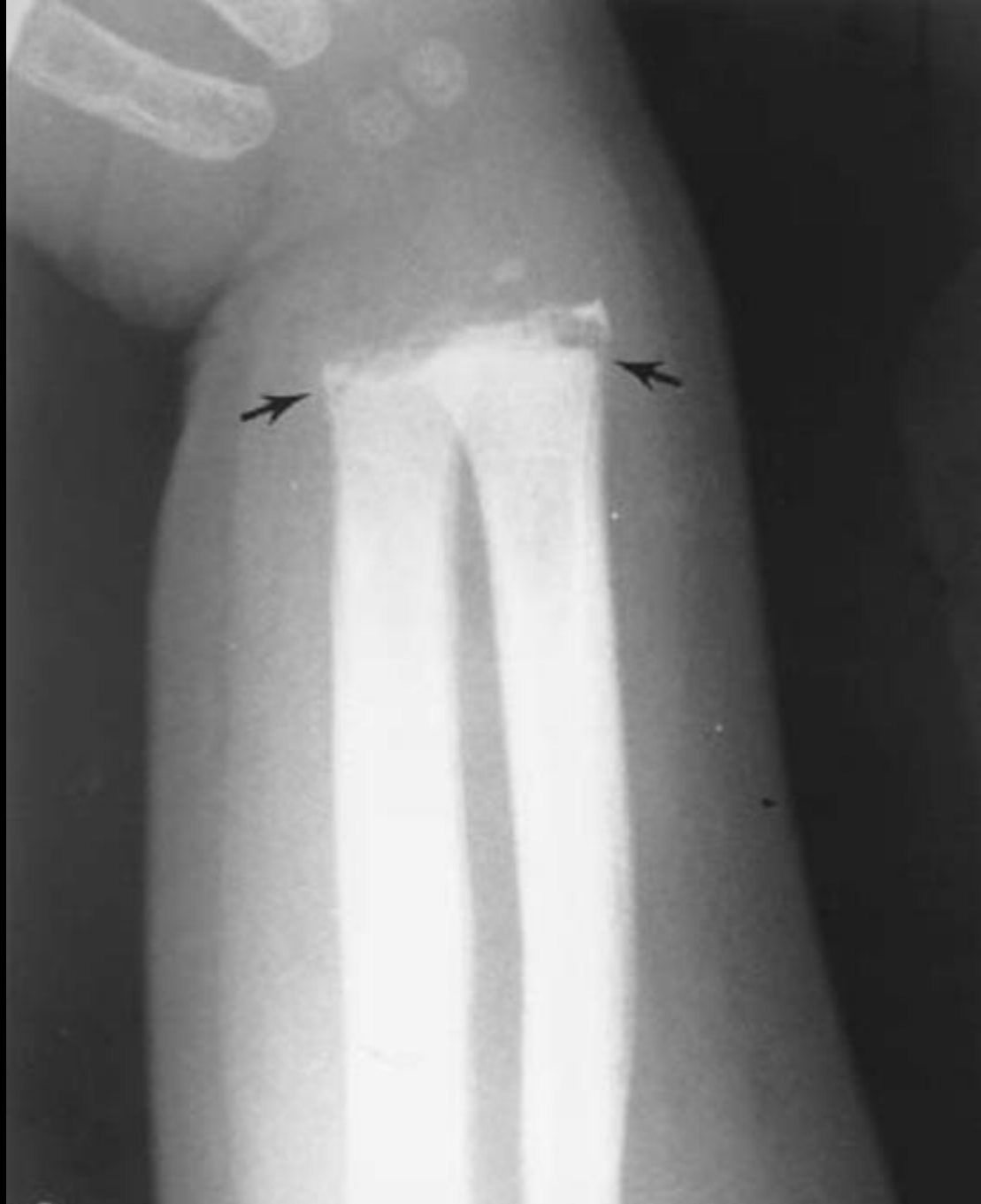
Metaphyseal injuries: child grabbed, swung, shaken, or pulled



A: good view of a classic metaphyseal lesion



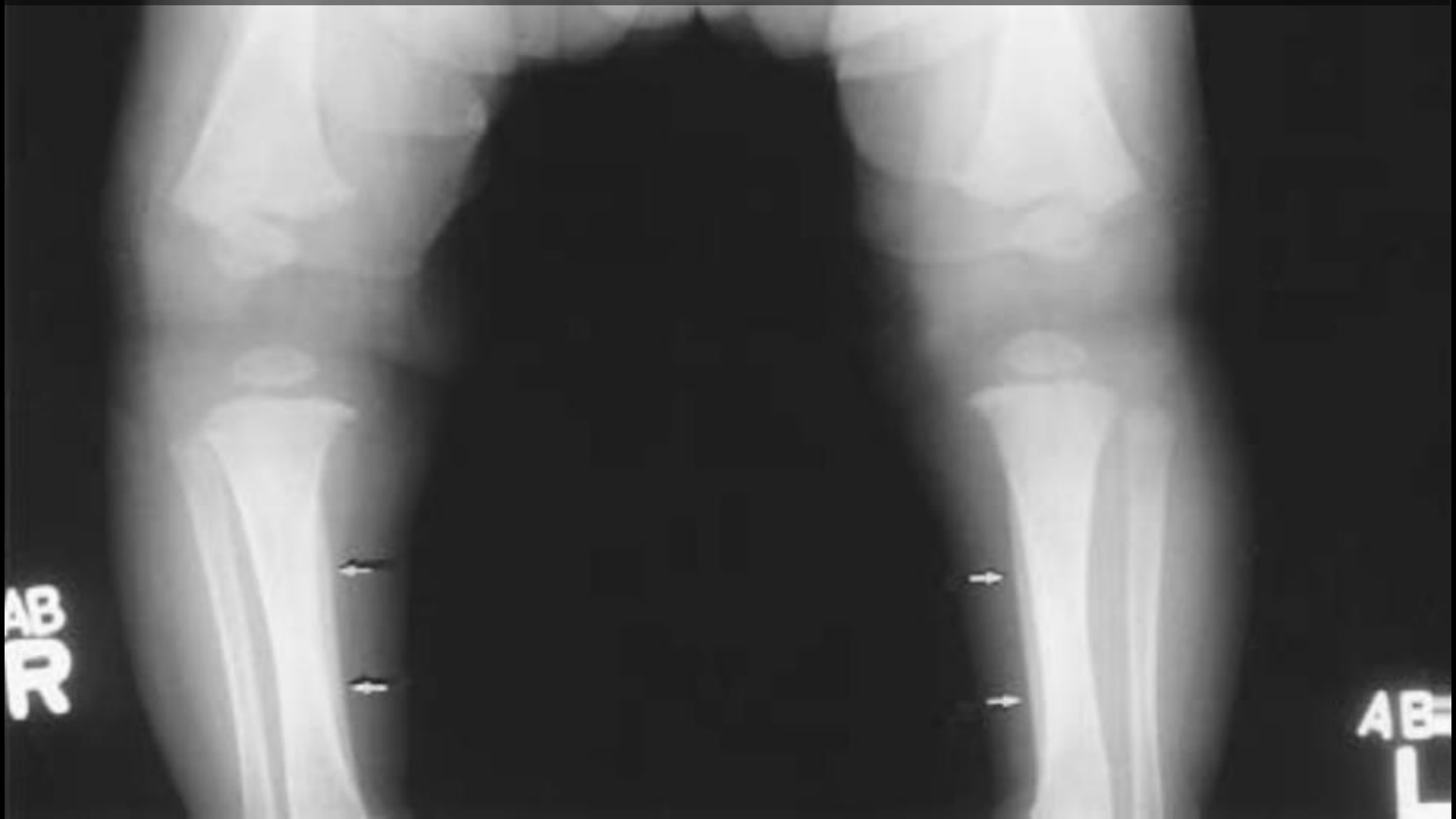
B: infant knee classic “bucket-handle” fracture of the distal femur and “corner fractures” of the proximal tibia (arrows).



C: "corner fracture" of the distal radius and ulna.

Periosteal new bone: twisting and pulling

Physiological periosteal elevation in a 4-month-old infant. It is unilamellar, thin, and bilaterally symmetric (arrows). There are similar changes, less well seen, on the lateral aspects of the femoral diaphyses.

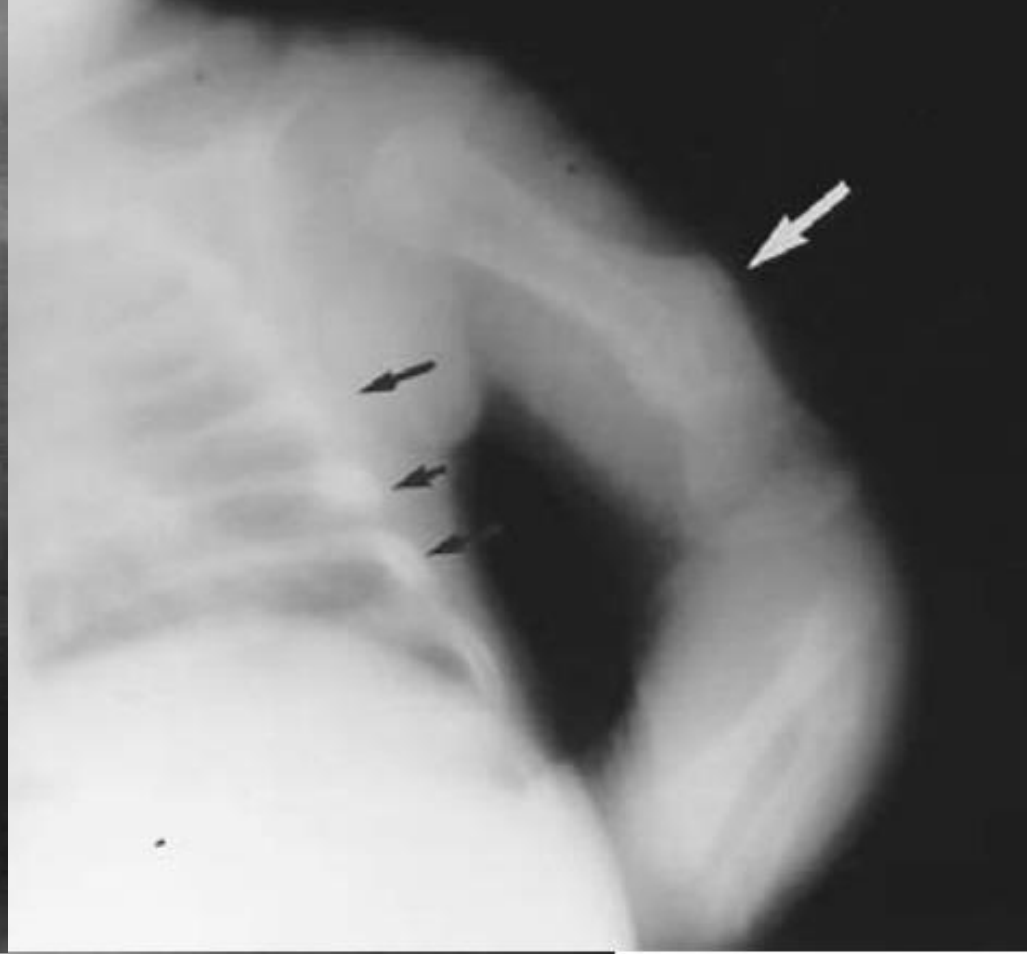


Diaphyseal spiral fractures: result from twisting or torsion forces



Healing spiral fracture of the humeral diaphysis extending into the metaphysis. The periosteal reaction suggests the injury probably is about 3 to 4 weeks old

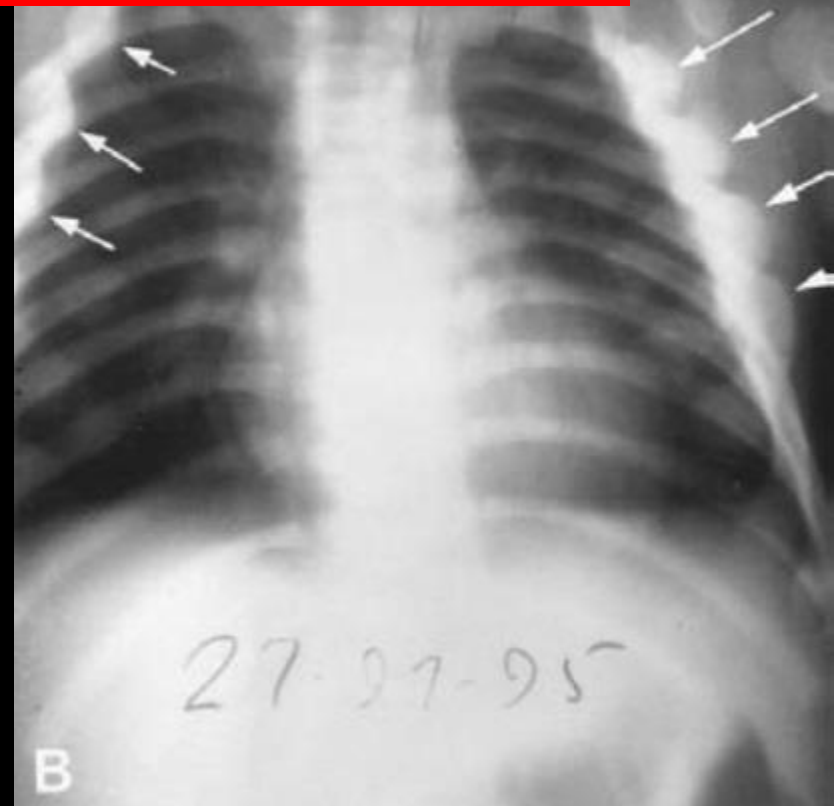
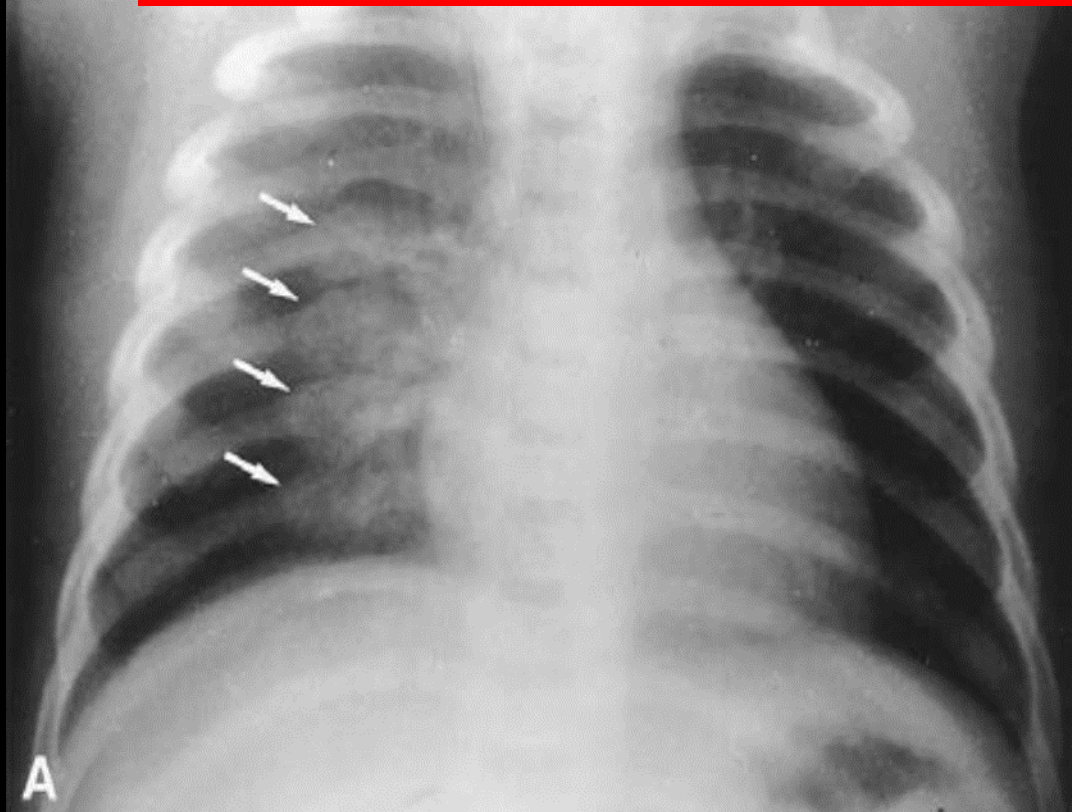
Transverse long bone fractures. grabbing and swinging forces



A: deformed healing transverse fracture of the femur in a 4-month-old abused infant.
B: almost completely healed transverse fractures of the humerus with residual angulation (large arrow). There are lateral rib fractures as well (small arrows).

have a high specificity for child abuse in the non-ambulatory child, related to abusive grabbing and swinging forces which cleanly snap the bone

Rib Fractures - grasping the child with anterior compression

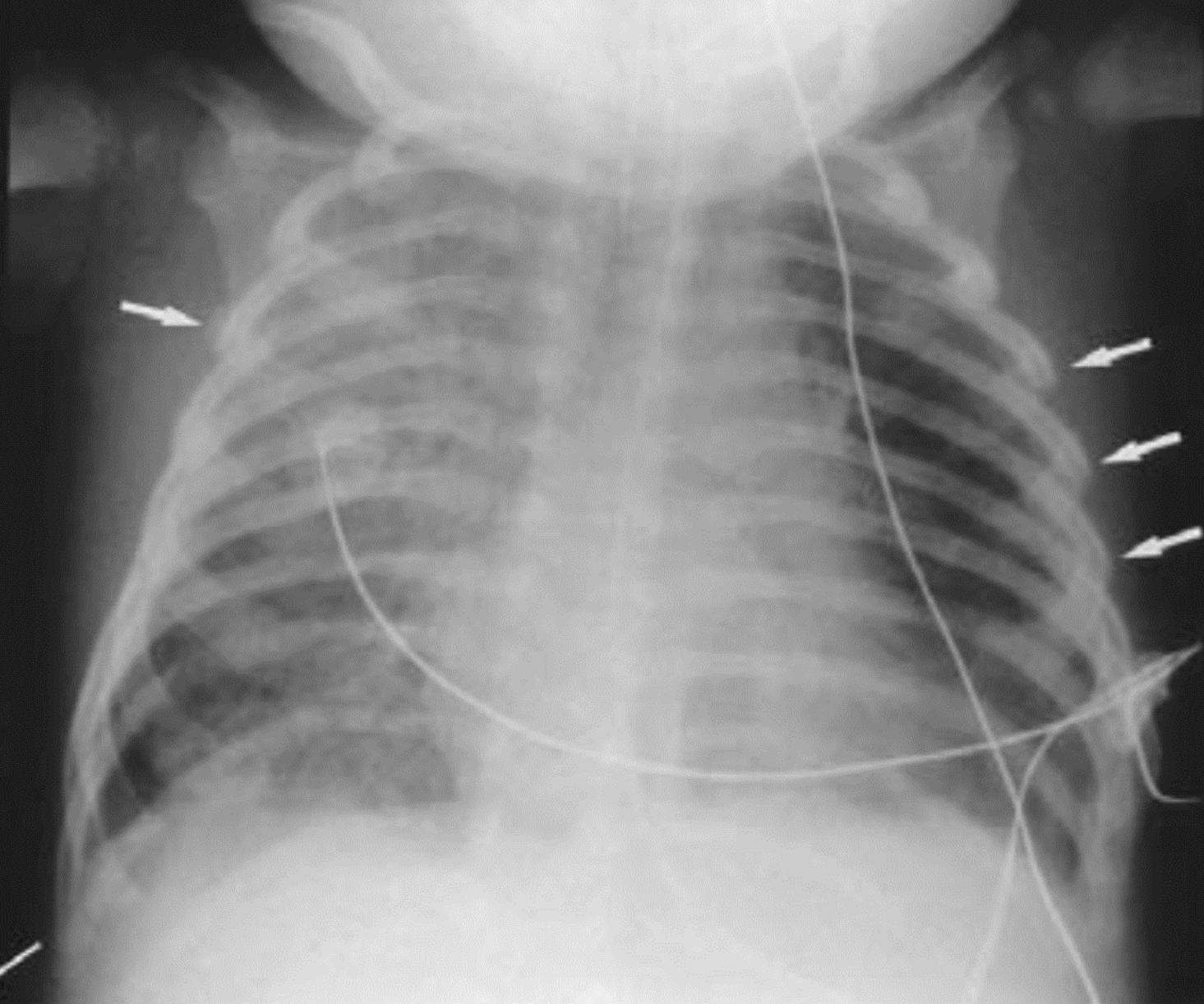


Rib fractures.

A: typical healed posterior fracture from AP compression.

B: healed lateral rib fractures.

Rib Fractures - grasping the child with anterior compression



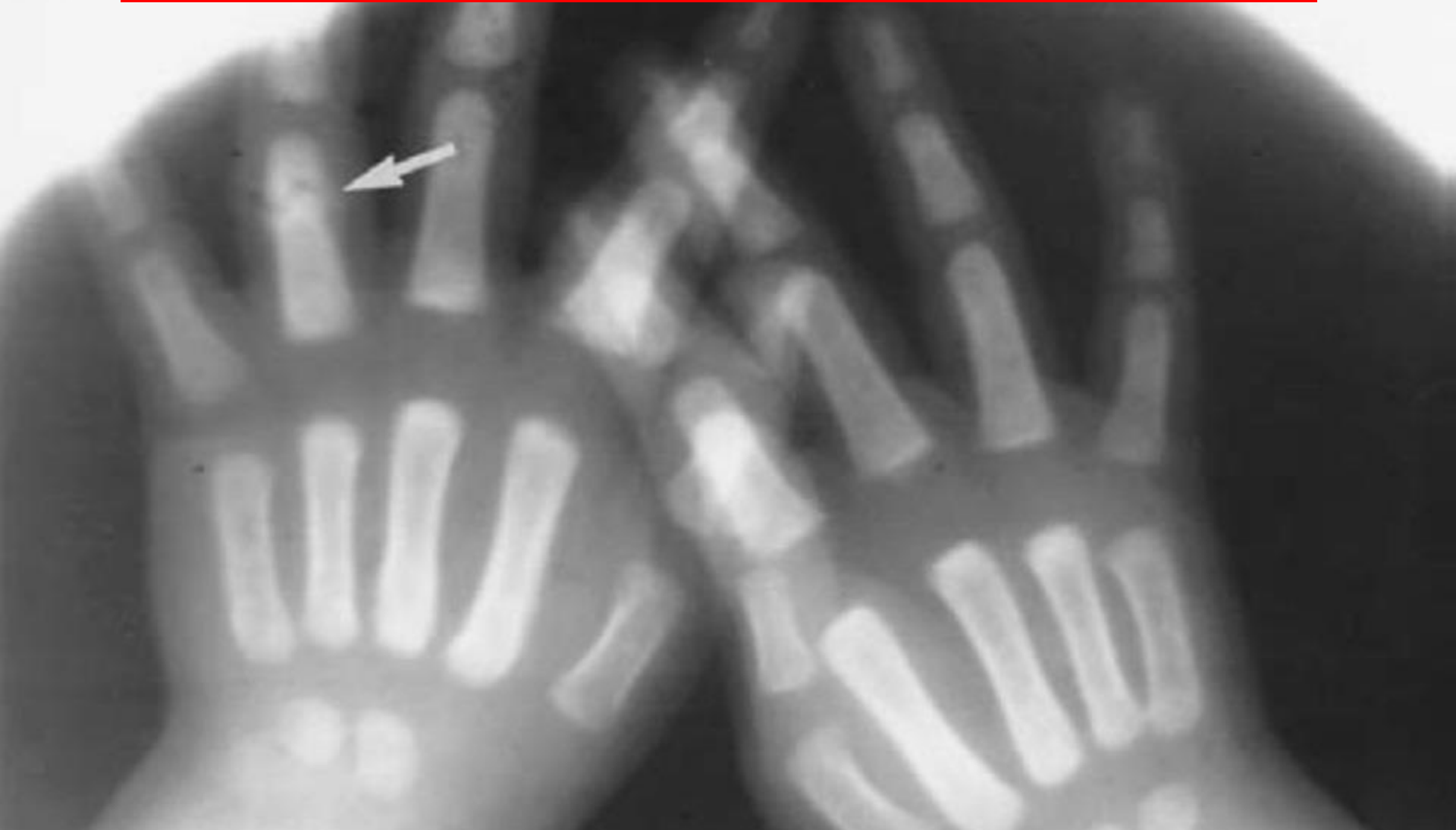
C: acute rib fractures (arrow) were missed and the baby sent home, then >>>>

Rib Fractures - grasping the child with anterior compression



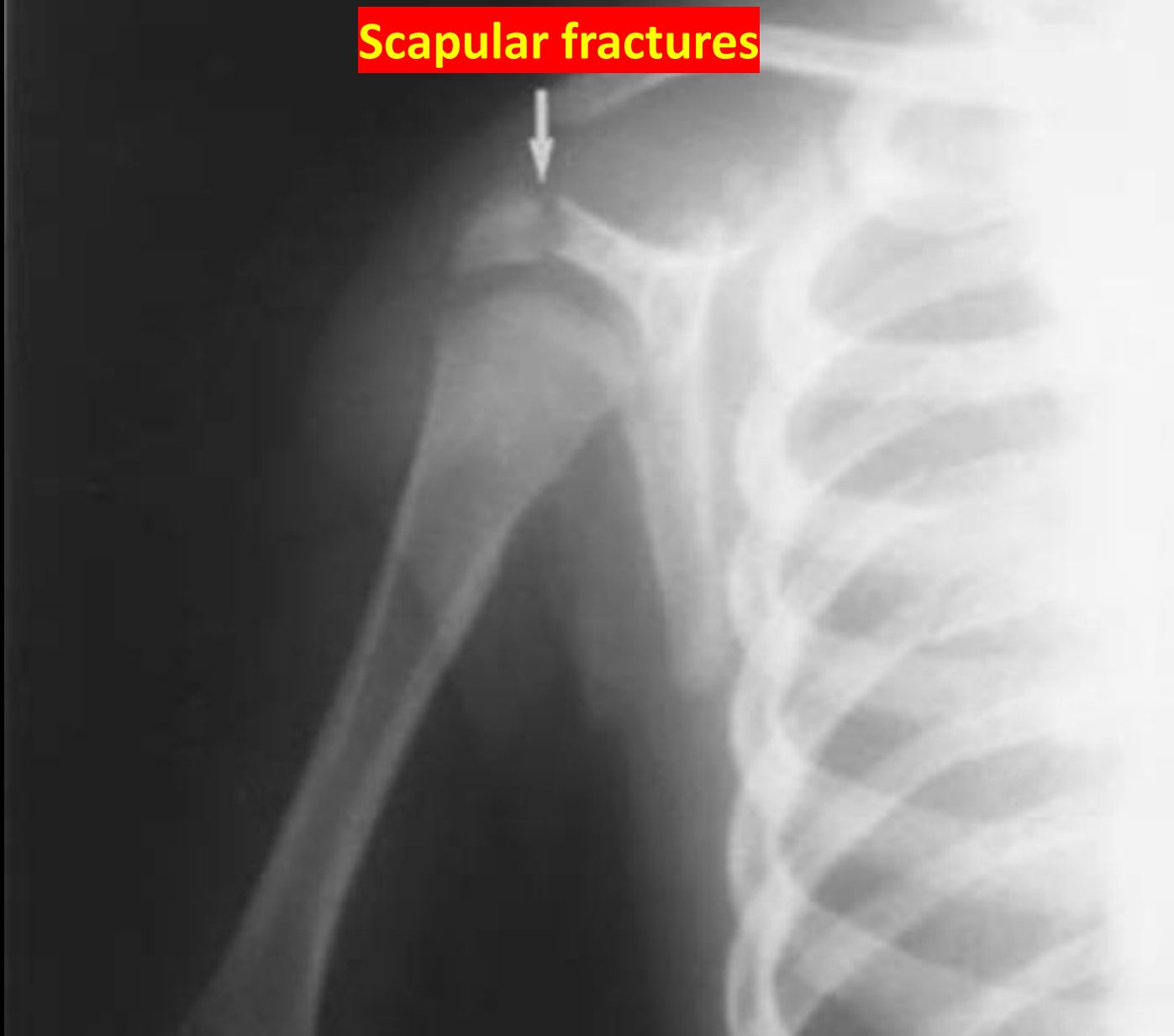
D: then returned, with multiple bilateral healing fractures (note hazy callus surrounding ribs). At this time the infant also had a skull fracture.

Rib Fractures - grasping the child with anterior compression



This 22-month-old The broken proximal phalanx (arrow) is further evidence of abuse. When social workers went to the home, they found a brain-damaged abused sibling. Except for fractures of the distal phalanx of the fingers from closing doors, hand and feet fractures are quite rare in infants and children and highly suspicious for abuse

Scapular fractures



Scapular fractures: are highly suspicious for child abuse and usually involve either the blade, more commonly, the acromion. Care must be taken to differentiate a true fracture from an ununited apophysis

Other fractures

Clavicle fractures: are the most common perinatal fracture, occurring typically in the midshaft. are practically never seen in child abuse. injuries to the lateral end of the clavicle may be a component of shaking.

Vertebral body fractures and the **Spinous processes** fractures and **Sternum fractures** are rare.

Cervical injuries are slightly more common.

Multiple fractures and fractures of different ages

Condition that mimic
child abuse

Condition that mimic child abuse

The most popular entity for this purpose is osteogenesis imperfecta.

Congenital syphilis

Ricketic conditions

Caffey's disease

Leukemia

prostaglandin E therapy to keep the ductus open in congenital heart disease

Menkes' syndrome (kinky-hair disease)

Neuroblastoma

Metastases

Scurvy

Osteomyelitis

Methotrexate therapy

Myelodysplasia

Congenital indifference to pain (very rare)

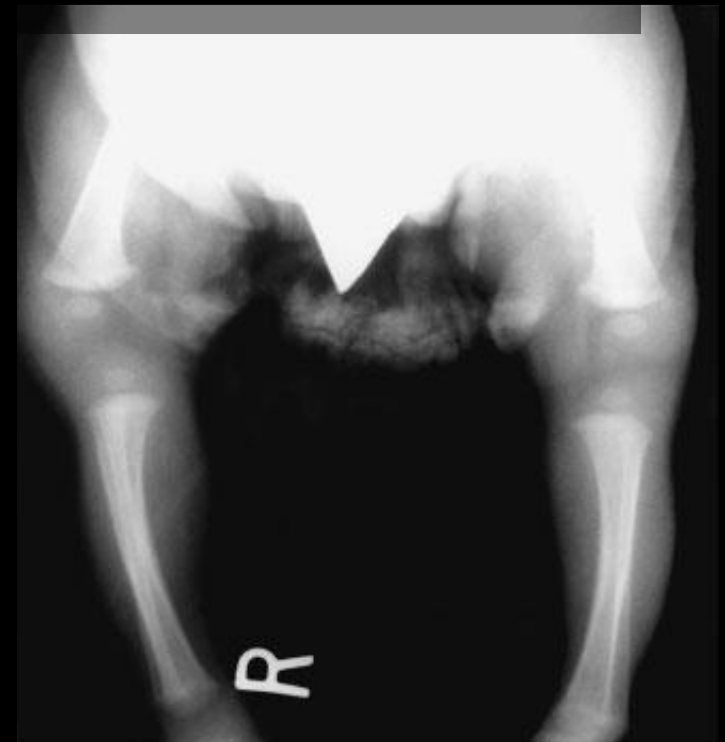
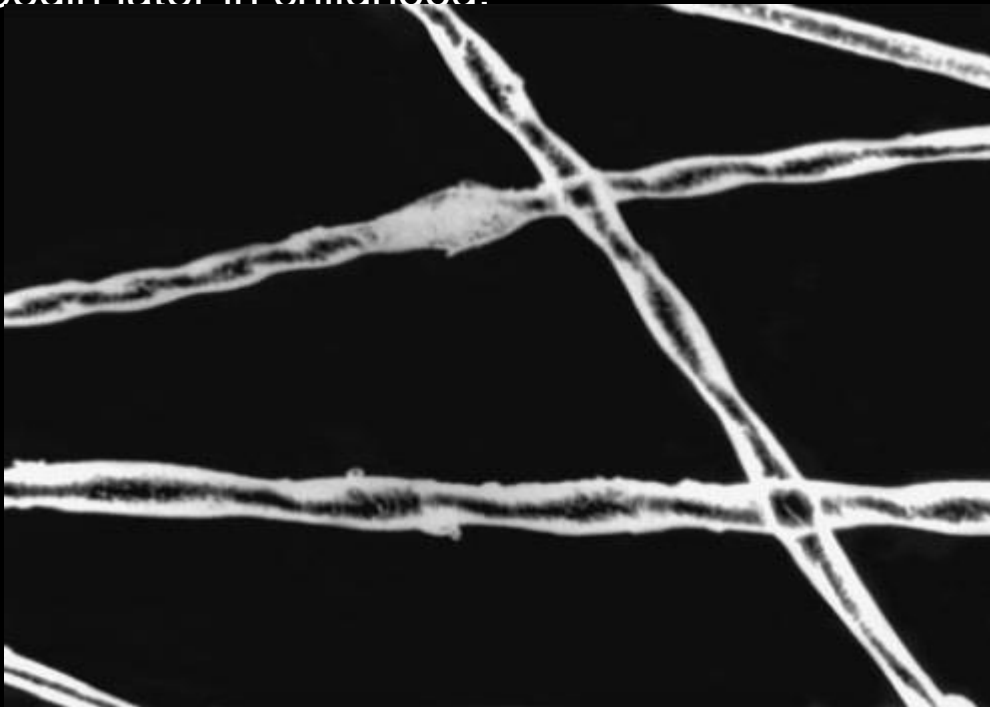
Schmid-like metaphyseal chondrodysplasia

Dilantin® therapy

Normal variants. periosteal new bone. spurring and cupping of metaphyses

Fractures of the extremities during childbirth

Menkes syndrome is a disorder that affects copper levels in the body. It is characterized by sparse, kinky hair; failure to gain weight and grow at the expected rate (failure to thrive); and deterioration of the nervous system. Additional signs and symptoms include weak muscle tone (hypotonia), sagging facial features, seizures, developmental delay, and intellectual disability. Children with Menkes syndrome typically begin to develop symptoms during infancy and often do not live past age 3. Early treatment with copper may improve the prognosis in some affected individuals. In rare cases, symptoms begin later in childhood.



They may show rachitic-like bony changes related to copper deficiency



Osteogenesis imperfecta (OI) is a group of genetic disorders that mainly affect the bones. It results in bones that break easily. The severity may be mild to severe. Other symptoms may include a blue tinge to the whites of the eye, short height, loose joints, hearing loss, breathing problems, and problems with the teeth.

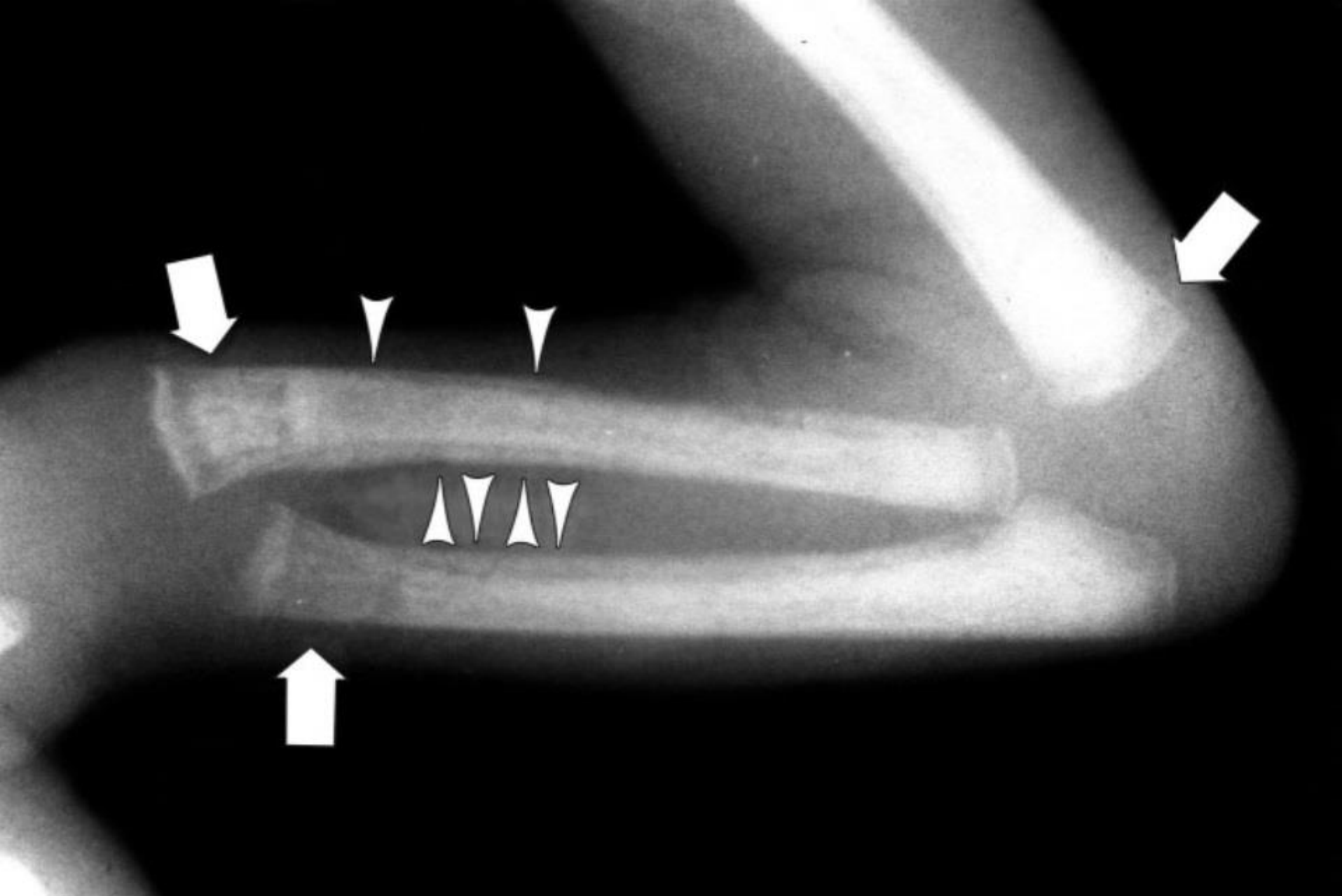
The underlying mechanism is usually a problem with connective tissue due to a lack of type I collagen an autosomal dominant manner



Osteogenesis imperfecta, characterized by: (A) thin gracile osteoporotic bones deformed by healed fractures; (B) acute fractures heal with superabundant callus.



Osteogenesis imperfecta



Congenital syphilis in a newborn. Characterized by destructive metaphyseal lesions (arrows) and periostitis (arrowheads).



Rickets. Softened, osteomalacic bone with bending fractures, periosteal reaction, widened and frayed metaphysis with no zone of provisional calcification



Intrauterine rubella (German measles) infection producing linear radio lucencies in the metaphysis. This has been described as the celery stalk appearance. It is not exclusive to rubella. Some other intrauterine infections will have a similar appearance.

End of Part One

References:

1. Forensic pathology reviews, Volume 3 / edited by Michael Tsokos. ISBN 1-58829-416-1
2. A radiologic atlas of abuse, torture, terrorism, and inflicted trauma ISBN 0-8493-1533-6
3. Forensic radiology ISBN 0-8493-8105-3