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Preface

The advantage of working in an environment with a plethora of clinical pathology is that one's ability at visual diagnosis becomes finely tuned. Armed with a digital camera and a consent form, an enthusiastic clinician can quickly build a library of educational material in the form of clinical pictures, radiographic images and fascinating stories.

The demands of increasing productivity, decreasing reimbursement from the third party payers and increasing numbers of patients, have led to the training of a generation of physicians who spend their time deciding what tests to order instead of observing and examining their patients. The art of visual diagnosis is an endangered species. The luxury of pondering over a diagnosis with exciting anticipation of the outcome no longer exists. Where once the bedside experience was the highlight of our clinical day, the â art â has been replaced by mechanics. Our trainees are being schooled in processing flow and survival mode ideation.

Sir William Osler once wrote: â Avoid the common and fatal facility of reaching conclusions from superficial observations and being constantly misled by the ease with which our minds fall into the ruts of one or two experiences.â The more patients one sees and examines the better one becomes at forming a concise differential diagnosis prior to ordering an expensive, time consuming and often invasive work up. The student of visual diagnosis is not only more likely to make the right diagnosis, but is also more likely to avoid the costly error. We urge our fellow physicians to hold on to the art. By perfecting the tools we were born with and supplementing them with those which we developed, we will continue to have pride in what we do, love our patients and enjoy our careers.

We have made an attempt to write this *Atlas* in the simplest, most understandable and most user friendly manner for the clinicians. Unlike the other books of this type, this *Atlas* features a *consistent format*. The images are presented in the medical sections with a *Definition followed by Etiology, Associated Clinical Features including* appropriate *laboratory* work-up and *Consultation*. The typical *Clinical Features and Differential Diagnosis* are presented in a box format to provide at-a-glance review of essential diagnostic information. The *Emergency Department Treatment and Disposition* are then emphasized. Each entity ends with *Clinical Pearls* highlighting all the most important â need-to-knowâ take home clinical information. *Epidemiology, pathophysiology, pharmacokinetics* and toxicity are discussed as indicated. The orthopedic and trauma sections begin with *Mechanism of Injury* followed by *Associated Clinical Features, Consultation, Complications, Emergency Department Treatment and Disposition.* Once again a box format is used for the ease of reference and a quick review highlighting *Clinical Features, Differential Diagnosis or Clinical Pearls.*

This *Atlas* is intended to assist the busy clinician in diagnosis, work-up and disposition. It was written for

anyone who steps foot into a Pediatric Emergency Department and has the privilege of taking care of children. It is also the hope of the authors that the experiences we have had and the images we have captured will stimulate the clinicians who are starting their careers to never stop asking questions, always strive to improve the art of visual diagnosis, work on eliminating any fear of patient contact and never stop learning from your patients.

Ars longa vita brevis (Translation: Art is long while life is short). With this quote, Hippocrates reminds us how much there is to learn in a short period and thereby (hopefully) inspire us to be humble, scholarly and better doctors.

Michael Lucchesi, MD
Binita R. Shah, MD

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Note: Large images and tables on this page may necessitate printing in landscape mode.

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Pediatric Atlas > Chapter 1. Child Maltreatment >

Child Abuse

Synonyms

"Battered child syndrome"

Child victimization

Definition

The Child Abuse Prevention and Treatment Act which was passed in 1974 defines child abuse as: "The physical or mental injury, sexual abuse, negligent treatment, or maltreatment of a child under the age of 18 by a person who is responsible for the child's welfare under circumstances which indicate that the child's health and welfare is harmed or threatened thereby." The key aspect of child abuse is maltreatment of a child by parents, guardians, or caregivers. The maltreatment may be in the form of direct physical or sexual abuse, denial of nutrition or medical care, or failure to provide a safe, nurturing environment.

Associated Clinical Features

1. Over 3 million cases of child abuse and neglect are reported annually with an annual mortality of greater than 4000 children.

2. Mechanisms of inflicted injuries range from direct impact (e.g., punching, slapping, or hitting with an object), shaken impact syndrome, penetrating injuries, and injuries related to asphyxiation.

3. Some characteristics of victims of abuse include premature birth, congenital defects, mental retardation, and multiple births.

4. Some characteristics of abusive families include a history of substance abuse, single parent household, young parental age, lack of education, previous incidents of domestic violence, socioeconomic constraints (e.g., poverty and unemployment), and mental health problems.

5. Presenting signs and symptoms range from asymptomatic presentations (e.g., bruising) to seizures, coma, or death, and may involve:

a. Bruises and contusions (Fig. 1-1; most common injuries of child abuse)

b. Abusive head trauma (Fig. 1-2; most common cause of death from child abuse)

c. Blunt abdominal trauma (this carries the second highest mortality rate related to abusive injuries). Inflicted abdominal injuries include ruptured liver or spleen, intestinal perforation, duodenal hematoma, pancreatic injury, and kidney trauma.

d. Skeletal injuries (see Figs. 1-7, 1-8, and 1-9)

e. Burns (see Figs. 1-22 and 1-24)

f. Poisoning (e.g., poisoning by table salt with water restriction [presenting with hypernatremia], over-the-counter and prescription drugs, laxatives, ipecac, pepper, carbon monoxide, or illicit drugs).

g. Munchausen syndrome by proxy (a serious disorder of parenting in which illness in a child is either produced or simulated by a parent)

6. Physical examination should include growth parameters (height and weight [failure to thrive] and head circumference [rapidly increasing head size indicative of head injury]).

7. As indicated, evaluation of child abuse includes complete blood count (screening for anemia and platelet count, base line hemoglobin and hematocrit), liver function tests (elevation of transaminase seen with liver injury), and coagulation profile (exclude bleeding disorders).

8. Radiographic skeletal survey

a. A skeletal survey screening for occult fractures

1) Mandatory for all patients <2 years of age with evidence of physical abuse

2) Indicated in infants <1 year of age with evidence of significant neglect and deprivation

3) The yield from the skeletal survey decreases with increasing age, as the frequency of occult fractures decreases in older children (those between 2 and 5 years of age).

4) Instead of a skeletal survey, appropriate radiographs can be ordered based on the complaints of pain and/or the physical examination in older children.

b. A skeletal survey is usually *not* indicated for:

1) Children >5 years of age, because acute occult fractures are rarely present in this age group

2) Siblings of an abused victim without clinical evidence of physical abuse

3) Victims of isolated sexual abuse

9. Radionuclide bone scans

a. Bone scans can identify most fractures within the first 48 hours after an injury.

b. They are helpful in infants and young children with suspected abusive injuries with a negative skeletal survey.

c. They are helpful in detecting fractures in locations that are difficult to see radiographically (e.g., hands, feet, or ribs).

d. They are helpful for detecting recent fractures (<7- to 10-day-old rib fractures or subtle diaphyseal fractures).

e. They serve as a complementary test to radiography, when additional evidence of abusive injuries is required to establish the diagnosis of child abuse.

f. If a bone scan is used as an initial study, all positive areas must be evaluated further with radiography.

g. *Injuries cannot be dated on bone scans.*

h. They are insensitive for detecting cranial injuries.

10. All patients with suspected intracranial injury must undergo cranial CT or MRI or both. Strongly consider doing cranial CT scans in infants <1 year of age with abusive skeletal injuries.

11. Photographs are an important form of documentation. They are usually admissible in legal

proceedings as long as they are authenticated (label each photograph on the back with the name and medical record number of the child, the signature of the person taking the picture, and the date and time). A front view of the face (in order to confirm the identity of the child) must be included in addition to photos of the injuries (e.g., bruises).

12. An interview should be conducted in a closed environment with a child old enough to describe the mechanism of injury. These questions should be developmentally appropriate and open-ended (e.g., "Can you tell me what happened to your arm?"), rather than asking leading questions (e.g., "Did your mommy hit you?"). Document the child's and caregiver's *exact* statements about the child's injuries, verbatim.

Figure 1-1. Child Abuse

A. Bruise. Bruises are the most common injuries of child abuse. External evidence of inflicted injuries may be very subtle at times as seen in this 3-month-old infant who presented with inconsolable crying. She had a very small bruise in the periorbital region. A skeletal survey revealed a humerus fracture. *B*. Fractured humerus. An oblique fracture at the junction of middle and distal third of the humerus is seen. The humerus and femur are among the most frequently fractured long bones in abusive injuries. The most common type of abusive fractures are spiral (oblique) or transverse. A humerus fracture in a child <3 years of age should raise a strong suspicion of child abuse.

Figure 1-2. Subarachnoid Hemorrhage (SAH) and Subdural Hemorrhage (SDH); Shaken impact Syndrome

An autopsy photograph taken just prior to brain removal shows a SAH on the upper right hand side, SDH in the lower right hand side, and brain swelling with flattened gyral configuration. This 8-month-old infant was seen 4 weeks earlier because of bleeding from the ear, and was sent home with a diagnosis of otitis externa. Subsequently he was seen for facial palsy on the same side as the bloody otorrhea. He was treated with antibiotics with a clinical diagnosis of otitis media with facial palsy. A few days later, he was brought to the ED in cardiopulmonary arrest. He was also found to have skull and multiple rib fractures (otorrhea and facial palsy were found to be due to a basal skull fracture). *Remember: Otitis externa is an exceedingly uncommon diagnosis in infancy, and bloody ear discharge is neither seen in otitis media nor otitis externa.*

Figure 1-7. Fractures: Inflicted versus Accidental

A. Common fractures in childhood. (Illustrations by Alexander Imas, M.D.) *B*. Femoral shaft fracture; child abuse. An oblique, displaced fracture of the midshaft of the femur in a 4-month-old infant who was brought to the ED with a history of inconsolable crying. Diaphyseal fractures are the most common type of fractures seen in child abuse. The femur is one of the most frequently fractured long bones in abusive injuries. It requires significant force to break the femur; thus a spiral, oblique, or transverse fracture of the femur is highly suspicious of child abuse in an otherwise healthy infant. *C*. Toddler's fracture; accidental injury. A nondisplaced spiral fracture is seen at the distal third of the tibia in a 12-month-old infant. Toddler's fracture is usually seen in the distal third of the tibia in an ambulating or cruising toddler. A skeletal survey was negative and child abuse was excluded by a thorough investigation in this infant.

Figure 1-8. Classic Metaphyseal and Epiphyseal Injuries of Child Abuse

A. Metaphyseal-epiphyseal injuries are classic fractures of child abuse and can occur in any long bone adjacent to a growth plate. (Illustrations by Alexander Imas, M.D.) *B.* "Bucket-handle" fracture. Frontal view of distal tibia in a 4-month-old infant. Note the separation of a thin band of metaphysis, representing a "bucket-handle" fracture. (Reproduced with permission from: Shah BR, Laude TL: *Child Abuse and Sexual Abuse. Atlas of Clinical Pediatrics.* WB Saunders, Philadelphia, 2000, p. 36.)

Figure 1-9. Multiple Fractures; Child Abuse

Multiple fractures are seen in a 6-month-old infant at different sites on these radiographs. A spiral fracture of the proximal third of right tibia is seen *A.* A repeat radiograph taken 3 weeks later shows a diffuse periosteal reaction and substantial callus formation *B.* This infant also had a comminuted spiral fracture of the distal third of the left tibia and a transverse fracture of the left fibula (seen on the radiograph with a subperiosteal for-mation of new bone; *C*). He also had bilateral multiple rib fractures. Toddler or spiral fractures of the tibia in a child who is not walking or cruising is highly suggestive of abuse. The presence of multiple fractures (either injuries of different bones or more than one site of fracture within same bone) and/or fractures in different stages of healing suggests child abuse.

Figure 1-22. Forced Immersion Burns

A. As the child's buttocks are plunged into the hot liquid and held against the porcelain tub, the child instinctively flexes the hips. The burn is well demarcated (A). The crease between the thigh and abdomen is spared (B). *B.* The area of the buttocks that is held against the relatively cooler tub is less severely burned and gives rise to the "hole-in-a-doughnut" pattern (C). The child's heel may come into contact with the hot liquid, and the burn is well demarcated (*AandB*). *C.* Stocking burns. A 20-month-old infant whose feet got dirty and reportedly was left in a basin of hot water. Stocking burns of the feet up to both ankles are due to submersion in scalding water. *D.* A $2^1/_2$-year-old with severe immersion burns to the buttocks and feet. Note evidence of previous healed immersion burns to the same areas. The child was not taken for medical care until she presented with severe brain injury. A skeletal survey revealed a healing supracondylar fracture of the right humerus. (Reproduced with permission from: Giardino AP, Christian CW, Giardino ER: *A Practical Guide to the Evaluation of Child Physical Abuse and Neglect.* Sage Publications, Thousand Oaks, CA, 1997, pages 82-84 and 89.)

Figure 1-24. Contact Burns

A. Burn from an iron inflicted on this patient by her stepfather during an argument. *B.* A well-defined area of burn inflicted on this child by a heated spoon. *C.* An 8-month-old infant with second- and third-degree burns of the lower extremity inflicted by a hot object because "he was crying too much."

Consultations

A multidisciplinary team effort should be used (as indicated depending on the injuries), with consultations from a pediatrician, a child abuse consultant, and a social worker, as well as a specialist in pediatric radiology, neurosurgery, surgery, and ophthalmology.

Emergency Department Evaluation and Disposition (General Guidelines)

1. For management of specific injuries and hospitalization, please refer to the sections on the individual entities.

2. All 50 states have child-protection ordinances mandating that professionals who come into contact with children report cases of suspected abuse to the local child protective services agency.

3. Legal issues regarding reporting child abuse:

a. The law requires reporting all cases of *suspected (but not necessarily proven) as well as known cases of child abuse or child sexual abuse.*

b. Report to child protective and law enforcement agencies as indicated by local law.

c. *Mandated reporters* are those individuals who are routinely responsible for a child's health or well-being, and may include medical personnel, teachers, day care workers, and law enforcement professionals.

d. Mandated reporters who report their suspicions in good faith are protected from lawsuits.

e. A mandated reporter may be prosecuted for failing to report abuse, and civil malpractice litigation may be brought against a physician or other health care practitioner for failure to recognize or diagnose child abuse or child sexual abuse.

f. In cases in which a false report is filed, statutes generally provide immunity as long as the report is done in good faith.

4. Documentation in the medical record should be made with great care with a very clear, concise, and legible history, physical examination, and laboratory and radiological findings, because such records may become evidence in a criminal prosecution.

5. Once a diagnosis of abuse is considered likely, the ED physician, in consultation with child protective service workers, must make a decision about the safe disposition of the child and the possibility of further harm if the child returns to the custody of the caregiver in question. Options include immediate placement in foster care (either with a relative or designated foster parent), or temporary hospitalization while awaiting arrangements for transport to a safe environment.

6. Referral to mental health professionals should be made for both the victim and their innocent relatives or caregivers to help them to cope with the emotional trauma of abuse.

7. Once a diagnosis of child abuse or child sexual abuse is made, all other siblings or other minors should be evaluated, if they were also in contact with the alleged perpetrator.

Clinical Pearls: Child Abuse

1. *Any injury to a minor who presents to a clinician may be the result of child abuse.*

2. Openness to a diagnosis of child abuse and/or neglect is *paramount* when examining a child who is potentially injured or abused.

3. It is important to undress the child completely so that a thorough examination may be carried out to evaluate for integumentary or other occult injuries.

4. Remember that many children who are physically abused may also be sexually abused. Exclude sexual abuse by taking a thorough history and performing a thorough physical examination, and order laboratory studies as indicated.

5. Red flags for child abuse include inconsistent, unexplained, and implausible history; delays in seeking treatment; and a history of repeated accidents.

Box 1-1. A Full Skeletal Survey

Anteroposterior (AP), posteroanterior (PA), lateral, or oblique views:
AP and lateral views of axial skeleton:
 AP and lateral skull
 Lateral cervical spine
 AP and lateral thorax
 AP pelvis (including mid and lower lumbar spine)
 Lateral lumbar spine
AP views of appendicular skeleton
 AP humeri
 AP forearms
 Oblique PA hands
 AP femurs
 AP lower legs
 AP feet
Important:
 A follow-up skeletal survey about 2 weeks after the initial study increases the diagnostic yield and should be considered when abuse is strongly suspected.
 AP and lateral views of the skull must be taken even when cranial CT has been performed, because skull fractures coursing in the axial plane may be missed with axial CT.
 Oblique views of the thorax increase the yield for detection of rib fractures.
 A "babygram" or full body radiograph (of the entire infant or young child on one or two radiographs) is *NOT acceptable.*
 An abbreviated skeletal survey is *NOT acceptable.*
 At least two views of each fracture should be taken for complete delineation.

Box 1-2. Dating of Bone Injuries

Dating of the fractures
 (1) Helps in estimating age of injury
 (2) Helps in identifying multiple episodes of trauma, inflicted at different times

(3) Is based on callus formation, appearance of periosteum, fracture line and soft tissues seen on radiographs

Age of Injury	Bone Appearance on Radiograph
0â 2 days	Fracture
	Soft tissue swelling
0â 5 days	Visible fragments
<10â 14 days	None or minimal periosteal new bone
10â 14 days	Immature callus formation
	Periosteal new bone with calcified periphery and radiolucent center
>21 days	Dense mature callus (uniformly dense and smooth)
>3 months	Only thickened cortex

Box 1-3. Differential Diagnosis of Child Abuse

Accidental trauma
Conditions mimicking abusive bruises (see Box 1-5)
Conditions mimicking abusive burns (see Box 1-18)
Sudden infant death syndrome or infanticide
Metabolic conditions with an increased tendency for fractures (see Box 1-8)
Suspect child abuse with any of the following:
Multiple injuries
Injuries in different stages of healing
Delay in seeking medical care
Inconsistent history
Injuries inappropriate for child's stage of development
When the alleged mechanism of injury is not consistent with clinical findings or the child's stage of development
Frequent episodes of "accidental" poisoning

Cutaneous Manifestations of Child Abuse

Definition

1. Cutaneous manifestations of child abuse include bruises, bite marks, and burns.

2. The most common injuries identified in abused children are bruises.

3. A bruise results when blunt force is applied to the skin surface resulting in disruption of capillaries, and with greater force larger blood vessels, leading to extravasation of blood into the dermis or subcutaneous tissues.

Associated Clinical Features

1. The skin usually is the first place abuse becomes apparent, before visceral, skeletal, and CNS injuries become obvious.

2. When the injury is inflicted by hands, belts, cords, ropes or bites (Fig. 1-3 and 1-4*A*), bruises appear in distinctive patterns. Cords, belts, and ropes can be looped, leading to U-shaped bruises (Fig. 1-4*B*). Linear, rigid objects (e.g., cooking utensils) lead to linear bruises. Sometimes marks are left by the hands of the abuser (Fig. 1-5).

3. For each bruise or contusion document its color, shape, pattern, location, and size (Fig. 1-6).

4. A CBC, platelet count, and coagulation studies (prothrombin time and partial thromboplastin time) may help when a bleeding disorder is suspected. Additional tests like bleeding time and coagulation factors may be indicated in selected cases. Clotting studies may be helpful or lead to confusion at times (e.g., after serious head injury, clotting studies may be abnormal because of consumption of coagulation factors in response to injury). A family history of bleeding disorders will also help (e.g., hemophilia as an X-linked recessive disorder [most commonly seen in males only]).

Figure 1-3. Bite Marks

A, B. Bite marks lead to a very distinctive pattern of bruises. They should be suspected when ecchymosis, lacerations, or abrasions are found in an elliptical or oval form (two arched patterns that appear as mirror images of one another if both mandibular and maxillary teeth are used to bite). Canine marks in a bite are the most prominent (or deep) part of the bite. The normal distance between maxillary canine teeth in adult humans is 2.5 to 4 cm, and in a child it is <3 cm. If the intercanine distance is <3 cm, the bite mark may have been inflicted by a child; if it is >3 cm, it was probably inflicted by an adult. As seen here, human bites compress flesh, causing only contusions; animal bites (dogs and other carnivorous animals) tear flesh. Recent bites (and those in a child who has not been bathed) can be swabbed with a saline-soaked cotton swab and sent for DNA analysis, which may help in identifying the perpetrator.

Figure 1-4. Marks Due to Child Abuse

A. Marks from objects. (Reproduced with permission from: Johnson CF: Inflicted injury versus accidental injury. In: *Child Abuse.* Pediatric Clinics of North America. WB Saunders, Philadelphia, Vol. 37, No. 4, August 1990, p. 791). *B.* Loop and linear marks from electrical cord; inflicted injuries.

Figure 1-5. Finger Patterns of Child Abuse

A. Finger patterns seen on the face of the same infant shown in Fig. 1-2. *B.* Gloved fingers corresponding to the finger patterns shown in A.

Figure 1-6. Inflicted Bruises

A. Bruises on the relatively well protected areas suggest inflicted injuries. Purple bruise (about 3 to 5 days old) around periorbital region and red bruise (about 1 to 2 days old) on the nasal bridge seen here represent new bruises. *B.* Red bruise (new bruise about 1 to 2 days old) and scratch marks are seen on both cheeks in this infant who was left with his mentally retarded brother. He also had human bite marks on his trunk. *C.* Ears are not frequently injured in childhood accidents. Bruises at these sites are strong indicators of abuse. Ears can be bruised by pulling, pinching, or grabbing them. Inflicted bruises are typically seen on top of the pinna. Pulling the ears can also cause bruises at the junction between the ears and head posteriorly.

Consultations

A multidisciplinary team approach should be used (as indicated depending on the injuries) with consultations with a pediatrician, a child abuse consultant, a social worker, and specialists in pediatric radiology, neurosurgery, surgery, and ophthalmology.

Emergency Department Evaluation and Disposition

1. Management of bruises is generally supportive.

2. Assess cardiovascular stability in cases of deep bruises (e.g., thigh).

3. For general guidelines for reporting to child protective agencies, see Emergency Department Evaluation and Disposition (General Guidelines).

Clinical Pearls: Cutaneous Manifestations of Child Abuse

1. Bruises are the most common injury in physically abused children. Bruises are also a common accidental injury of childhood.

2. Dating of bruises is *NOT* absolutely accurate. The color of the bruise depends on its location, depth, and amount of bleeding and circulation in the bruised area.

3. *Remember:Those who can't cruise don't bruise* (meaning that any bruises in young infants who are not yet able to stand or walk should raise concern about abuse, with the exception of infants placed in walkers).

Box 1-4. Bruises

> *Location of bruise or contusion*
> Bruises on skin over bony prominences (areas first impacted during a fall) suggest accidental bruises.
> Examples:
>   (1) Anterior tibia (shins)
>   (2) Knees
>   (3) Elbows
>   (4) Forehead
>   (5) Lower arms and dorsum of hands
> Bruises on relatively well protected areas suggest inflicted injuries.

Examples:
  (1) Ears
  (2) Cheeks
  (3) Frenulum
  (4) Neck
  (5) Upper arms and trunk
  (6) Flanks
  (7) Buttocks
  (8) Genitalia/groin
  (9) Upper anterior and inner thighs

Determination of age of bruise or contusion
Dating bruises can be difficult due to the variability in their rate of progression.
Bruises are difficult to see on darkly pigmented skin.
The color of the bruise may appear different depending on the patient's skin tone.
The rate of healing of a bruise depends on:
  (1) *Location:* Bruises on the face or genitalia heal faster than bruises on shins due to their excellent blood supply.
  (2) *Depth:* Deep tissue bruises (e.g., thighs or hips) take longer to appear and longer to heal.
  (3) *Amount of bleeding:* Bruises with heavy bleeding take longer to heal.
  (4) *Circulation in the bruised area:* Bruises in areas with poor circulation take longer to heal.

Guidelines for color of bruises:
  (1) Red to blue: about 1 to 2 days old
  (2) Blue to purple: about 3 to 5 days old
  (3) Green: about 6 to 7 days old
  (4) Yellow to brown: about 8 to 10 days old
  (5) Resolved: at least 13 to 28 days old
  (6) It is likely safest to describe bruises as either "new" (red, purple, or blue) or "old" (green, yellow, or brown)

Note: The presence of bruises that have various ages may signify multiple episodes of injury caused by ongoing physical abuse.

Box 1-5. Differential Diagnosis of Conditions Mimicking Abusive Bruises

Accidental trauma
Raccoon eyes from accidental trauma (see Fig. 2-12)
Birthmarks
  (1) Mongolian spots (see Fig. 2-1)
  (2) Hemangioma (especially cavernous; see Fig. 7-57)
Infections
  (1) Systemic bacterial or viral infections associated with petechiae or purpura (see Figs. 3-30 and 3-31)
  (2) Severe infections with disseminated intravascular coagulation (see Figs. 3-28 and 3-29)
Coagulation defects
  (1) Hemophilia (factor VIII, IX, and X deficiencies)
  (2) Von Willebrand's disease
Vasculitis
Henoch-Schönlein purpura (see Fig. 11-8 and Figs. 7-13, 7-14, and 7-15)
Platelet dysfunction
Acute or chronic immune thrombocytopenic purpura (see Fig. 11-7)
Folk-healing practices (Coining, cupping and moxibustion see Fig. 2-2, 2-3, and 2-4)
Dermatological conditions
  (1) Phytophotodermatitis (see Fig. 2-11)
  (2) Cold panniculitis (see Fig. 2-5 and 2-6)

       (3) Subcutaneous fat necrosis
       (4) Erythema nodosum
       (5) Hypersensitivity reactions (e.g., erythema multiforme; see Fig. 7-5)
     Tattooing or dye stains
     Conditions associated with increased skin fragility and bruising
      (1) Osteogenesis imperfecta
      (2) Ehlers-Danlos syndrome

Skeletal Manifestations of Child Abuse

Associated Clinical Features

1. The reported frequency of fractures associated with child abuse varies from 11 to 55%.

2. Inflicted skeletal injures may involve any part of the axial and appendicular skeleton.

3. Age is the single most important risk factor for abusive skeletal injuries:

  a. Such injuries are seen more frequently in infants and young children than in older children.

  b. About 55 to 70% of all abusive skeletal injuries are seen in infants <1 year of age.

  c. About 80% of abusive fractures are seen in infants <18 months of age.

  d. Only 2% of accidental fractures are seen in infants <18 months of age.

    4. Intracranial and visceral injures often coexist with abusive skeletal injuries (Fig. 1-7). About 70% of abuse-related intracranial injuries have associated fractures.

5. Metaphyseal and epiphyseal fractures require forces that are not produced by the usual accidental trauma of infancy, and their presence should raise a strong suspicion for child abuse (Fig. 1-8). Salter-Harris fractures are relatively uncommon in abuse.

6. Radiographic studies that are used for detection of musculoskeletal trauma include a skeletal survey (see Box 1-1), radionuclide scans (see Associated Clinical Features), and MR imaging.

Consultations

A multidisciplinary team approach should be used (as indicated), with consultations with a pediatrician, a child abuse consultant, a social worker, and a specialist in pediatric radiology and orthopedics.

Emergency Department Treatment and Disposition

1. Skeletal fractures related to child abuse are rarely life-threatening; however, recognition of a skeletal injury may be the first indication of child abuse and it serves as an important diagnostic tool. While awaiting completion of the investigation, the patient usually requires hospitalization.

2. For guidelines for reporting cases of suspected abuse to the local child protective services agency, see Emergency Department Evaluation and Disposition (General Guidelines).

3. Diaphyseal fractures:

 a. Treatment depends on the type, location, and stage of the fracture, and age of the patient.

 b. Immobilization is usually required, with limitation of weight bearing for lower limb fractures.

4. Metaphyseal fractures usually heal without specific treatment and do not need immobilization.

Clinical Pearls: Skeletal Manifestations of Child Abuse

1. Multiple fractures at different stages of healing are pathognomonic for child abuse (Fig. 1-9).

2. Skull fractures, rib fractures and metaphyseal lesions are the predominant type of abusive injuries seen during infancy; long bone fractures are the most common skeletal injury after 1 year of age.

3. Inflicted fractures are more common in infants. Accidental fractures are more common once children become ambulatory. Thus, long bone fractures are more likely the result of accidental trauma after the age of 2 years.

4. Even though diaphyseal fractures are the most common type of fractures seen in child abuse, they are not pathognomonic for abusive injuries, and can also result from accidental injuries.

5. The hallmark finding in fractures caused by nonaccidental trauma is the lack of a plausible explanation.

6. Lack of changes in radiographic findings on a follow-up skeletal survey done approximately 2 weeks after the initial study helps in confirming normal anatomic variants or metabolic bone diseases (e.g., dysplasia) that mimics abusive injuries.

7. The body mass of an infant <12 months of age will not ordinarily generate sufficient force to fracture a normal bone in a simple fall from a crib, bed, or couch.

8. Tibial spiral fractures are usually due to accidental trauma unless they occur in nonambulatory young infants.

Box 1-6. Clinical Features of Skeletal Manifestations of Child Abuse

Clinical signs and symptoms in a young nonverbal infant:
 (1) Pain manifested by inconsolable crying or irritability
 (2) Crying with movement of affected limb
 (3) Decreased use of a broken extremity (pseudoparalysis)
 (4) Some fractures (e.g. metaphyseal or rib) may not be apparent on examination, and can only be identified by radiographs
 (5) Local swelling and tenderness may be present
 (6) External bruising may or may not be present over the fracture site
 The most common injuries are extremity fractures.
 Common injuries include diaphyseal fractures of the long bones (with femur and humerus fractures being most common), and those of the tibia, ulna, radius, and fibula.
 Common types of fractures include spiral or oblique (due to rotational or torsional forces applied

to the limb) and transverse (due to a direct blow or bending force).

Diaphyseal or metaphyseal fractures are most common.

Subperiosteal formation of new bone involving the diaphysis indicates abuse (it reflects the presence of a subperiosteal hemorrhage due to traumatic separation of diaphyseal periosteum due to excessive torsional forces).

Other sites of fractures that are seen in abuse include:
  (1) Fractures about the shoulder girdle (the clavicle, acromion, scapula, and humerus)
  (2) Fractures of the hands and feet
  (3) Spinal fractures
  (4) Craniofacial fractures (mandibular fracture)
  (5) Rib fractures (see Figs. 1-11 and 1-12)
  (6) Skull fracture (see Figs. 1-15 and 1-16)

Note: No diaphyseal fracture by itself is pathognomonic of child abuse.

Figure 1-11. Multiple Posterior Rib Fractures

An 8-month-old infant was admitted because of abusive head injury. He did not have any other evidence of external injury. These rib fractures were detected accidentally on skeletal survey. The patient was completely asymptomatic as far as rib fractures were concerned.

Figure 1-12. Multiple Rib Fractures

Multiple posterior rib fractures (ribs 5 through 11) were seen at autopsy in this 23-month-old infant who died of blunt trauma injuries that included laceration of the lung, liver, and heart.

Figure 1-15. Skull Fracture due to Abuse

Intermastoid incision of the scalp in an infant shows a linear skull fracture of the parietal bone. There was brain injury with swelling but no intracranial hemorrhage was noted.

Figure 1-16. Head Injuries due to Abuse

A. Skull fractures. Comminuted skull fractures can be seen radiating from areas subjected to traumatic force in a toddler with an inflicted head injury. This patient's head was slammed against the kitchen counter. He presented in coma with signs of increased intracranial pressure due to an epidural hematoma. (*B*).

Box 1-7. Child Abuse Fractures