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The Evaluation of Suspected Child Physical Abuse

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abstract

Child physical abuse is an important cause of pediatric morbidity and mortality and is associated with major physical and mental health problems that can extend into adulthood. Pediatricians are in a unique position to identify and prevent child abuse, and this clinical report provides guidance to the practitioner regarding indicators and evaluation of suspected physical abuse of children. The role of the physician may include identifying abused children with suspicious injuries who present for care, reporting suspected abuse to the child protection agency for investigation, supporting families who are affected by child abuse, coordinating with other professionals and community agencies to provide immediate and long-term treatment to victimized children, providing court testimony when necessary, providing preventive care and anticipatory guidance in the office, and advocating for policies and programs that support families and protect vulnerable children.

INTRODUCTION

Each year in the United States, Child Protective Service (CPS) agencies investigate more than 2 million reports of suspected child maltreatment, 18% of which involve concerns of physical abuse.[1] After investigation, more than 650 000 children are substantiated as victims of maltreatment, and over 1500 child deaths are attributed to child abuse or neglect annually. The majority of these deaths (80%) occur in children who are under 4 years of age. Over recent years, official child welfare statistics suggest a consistent decline in child physical abuse rates, but because these reports represent only cases investigated and confirmed by state CPS agencies, these trends may reflect changes in reporting practices, investigation standards, and administrative or statistical procedures.[2] Indeed, the reported incidence of child physical abuse is dependent on the source of data. Results from the Fourth National Incidence Study, a congressionally mandated periodic study on child abuse that reports national incidence for reported and nonreported child maltreatment recognized by community professionals, showed a decline in physical abuse from 1993 to 2006.[3] In contrast, researchers examining hospitalization rates for physical abuse have shown either no significant

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www.pediatrics.org/cgi/doi/10.1542/peds.2015-0356

DOI: 10.1542/peds.2015-0356

PEDIATRICS (ISSN Numbers: Print, 0031-4005; Online, 1098-4275).

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recent changes[4] or recent increases in hospitalizations for physical abuse.[5,6] These studies likely represent more severe abuse and suggest that multiple data sources are needed to understand the scope and severity of the problem. Adult reports of childhood experiences indicate that physical abuse is more common than statistics reported from any pediatric data source. For example, data from the National Epidemiologic Survey on Alcohol and Related Conditions, a nationally representative sample of the adult US population, indicate that 17.6% of American adults are estimated to have been physically abused during childhood.[7] Regardless of the data source, physical abuse that is identified, reported to CPS, and investigated represents only a small percentage of the abuse that children experience.

DEFINITIONS

The recognition and reporting of physical abuse is influenced by variations in both legal and personal definitions of abuse. The Federal Child Abuse Prevention and Treatment Act provides minimum standards to the states for defining maltreatment, but each state defines child physical abuse within its own civil and criminal statutes. The act defines child abuse as "any recent act or failure to act on the part of a parent or caretaker which results in death, serious physical or emotional harm, sexual abuse or exploitation" or "an act or failure to act which presents an imminent risk of serious harm."[8] State laws defining physical abuse vary widely, and defining terms such as "risk of harm," "substantial harm," "substantial risk," or "reasonable discipline" may not be further clarified in state legislation. Some state statutes require "serious bodily injury" or "severe pain" to define abuse, and variability in state definitions ultimately contributes to widely variable rates of documented abuse across states.[1] States vary in their acceptance of corporal punishment in schools, despite calls from the American Academy of Pediatrics for the abolishment of corporal punishment in schools by all states.[9] Personal, cultural, and professional experiences influence individual perceptions and definitions of abuse.[10] For example, when given hypothetical scenarios involving pediatric head trauma, pediatricians were more likely than pathologists to judge an event as abusive.[11] This finding may reflect differences in training, experience, and exposure to different populations of children. Ultimately, the variability in definitions influences consistent reporting practices across jurisdictions.

IMPACT OF PHYSICAL ABUSE ON PEDIATRIC AND ADULT HEALTH

Child maltreatment is a public health problem with lifelong health consequences for survivors and their families.[12] Adults who were maltreated as children have poor health outcomes, and there is accumulating evidence that early adverse childhood experiences are strong contributors to many adult diseases.[13–15] Both retrospective and prospective studies published in recent years have identified strong associations between cumulative traumatic childhood events including maltreatment, family dysfunction, and social isolation, and adult physical and mental health disease.[16–18] Few studies, however, have specifically examined the association between child physical abuse and child and adult health outcomes, in part, because many victims have suffered from more than 1 kind of maltreatment.[19,20]

Adults who self-report physical abuse when they were children are more likely as adults to report chronic physical and mental health conditions,[21] even when controlling for family background and additional adverse childhood experiences.[22] Adolescents who are victims of physical abuse have high rates of depression, conduct disorder, drug abuse, and cigarette smoking.[23,24]

For some children, physical abuse results in permanent disability, affecting their lifelong health in profound ways. For example, victims of abusive head trauma (AHT) have high rates of neurologic disability, including sight and hearing impairment, epilepsy, cerebral palsy, and developmental and cognitive delay.[25–27] Abused children may suffer permanently disfiguring injuries. Victims of physical abuse in childhood are at risk for developing a variety of behavioral problems including conduct disorders, physically aggressive behaviors, depression, poor academic performance, and decreased cognitive functioning.[28–30]

There is emerging recognition that adverse childhood experiences, including physical abuse, influence biological adaptations associated with how the brain, neuroendocrine stress response, and immune system function.[31] In turn, these changes are associated with physical and behavioral health impairments decades later.[32] The recognition that social and environmental exposures early in life are associated with biological changes that influence health across generations necessitates that future efforts at improving the health of the population require interventions that limit exposure to adverse childhood experience and reduce toxic stress in young children.[33] Pediatricians have a unique opportunity to lead efforts addressing the social determinants of health, and prevention and early identification of child maltreatment, including physical abuse, is an important responsibility of the pediatrician in practice.

RISK FACTORS FOR CHILD PHYSICAL ABUSE

Child abuse is a highly complex phenomenon in which parent, child,

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and environmental characteristics interact to place children at risk[34] (Table 1). Child physical abuse affects children of all ages, ethnicities, and socioeconomic groups, although racial and socioeconomic factors influence reports to CPS.[35,36] Boys experience slightly higher rates of physical abuse than girls, and overall, adolescents are more likely than other children to receive injuries from physical abuse.[37] However, because of their small size and vulnerability, infants and toddlers are at highest risk of fatal and severe physical abuse.[38] Risk factors for infant abuse include maternal smoking, the presence of more than 2 siblings, low infant birth weight, and being born to an unmarried mother.[39] Children with disabilities are at high risk for physical, sexual, and emotional abuse.[40,41] Young, abused children who live in households with unrelated adults are at exceptionally high risk of fatal abuse,[42] and children previously reported to CPS are at significantly higher risk of both abusive and preventable accidental death compared with peers with similar sociodemographic characteristics.[43] Strong evidence exists for the association between poverty and child physical abuse, and children who live in poverty are overrepresented in both the child protective and foster care systems.[3] Military families are at risk for child maltreatment, particularly at times of deployment.[44,45]

Specific family and community preventive factors mitigate some of the risks, including parental resilience, parent knowledge of child development and parenting, concrete support in times of need, social connections, and a child's ability to form positive relationships.[46,47] The presence of safe, stable, nurturing relationships and environments prevent maltreatment and are essential for healthy childhood.

These risk and preventive factors, while important for guiding the development of prevention and intervention strategies, should be considered as broadly defined markers, rather than strong individual determinants of abuse.[48] Parents who have inappropriate developmental knowledge and expectations of their children, those who lack empathy for their children, those with harsh or inconsistent parenting practices, and those who reverse parent-child roles are also at risk for abusing their children.[49] Additional discussion related to risk and preventive factors for child maltreatment can be found in the American Academy of Pediatrics (AAP) clinical report on the pediatrician's role in child maltreatment prevention.[34]

TABLE 1 Factors and Characteristics That Place a Child at Risk for Maltreatment

Child	Parent	Environment (Community and Society)
Emotional/behavioral difficulties	Low self-esteem	Social isolation
Chronic illness	Poor impulse control	Poverty
Physical disabilities	Substance abuse/alcohol abuse	Unemployment
Developmental disabilities	Young maternal or paternal age	Low educational achievement
Preterm birth	Parent abused as a child	Single parent
Unwanted child	Depression or other mental illness	Nonbiologically related male living in the home
Unplanned pregnancy	Poor knowledge of child development or unrealistic expectations for child	Family or intimate partner violence
	Negative perception of normal child behavior	

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MISSED OPPORTUNITIES FOR DIAGNOSING PHYSICAL ABUSE

Most injuries in children are not the result of abuse or neglect. Minor injuries in children are exceedingly common, and most childhood injuries do not require medical attention. Pediatric visits for injury are common, and millions of children are seen each year in emergency departments for injury.[50] Additionally, unusual accidental events happen to children and may result in injuries that are not characteristically seen from accidental causes.[51] Although anecdotal reports of fatal injury from short falls exist, fatal outcome from childhood falls is rare.[52] It has been estimated that the population-based risk of a short fall death for an infant or young child is <1 per 1 million young children per year.[53]

The identification of physical abuse can be difficult. Other than the perpetrator and the child, witnesses to the abuse are uncommon; perpetrators of the abuse infrequently admit to their actions; child victims are often preverbal and may be too severely injured or too frightened to disclose their abuse; and injuries can be nonspecific. Physicians are taught to rely on parents for accurate information about the child's history and may not be critical or skeptical of the information provided. Additionally, disbelieving parents or other relatives may intimidate or threaten physicians who raise concerns of abuse. These factors make it even more challenging to diagnose abuse.

Identifying suspected abuse and reporting reasonable suspicions to CPS can be one of the most challenging and difficult responsibilities for the pediatrician. Yet early identification and intervention to protect abused children have the potential to stop the abuse and secure the child's safety and mitigate toxic stress in victims; in some cases, early recognition of

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abuse can be life saving. There is evidence, however, that physicians miss opportunities for early identification and intervention.[54,55] This is especially true for infants and toddlers, who are at highest risk of life-threatening and fatal injuries at the hands of their caregivers.[56]

Proper management of minor but suspicious injuries provides an opportunity for early recognition and intervention to protect vulnerable children. Previous sentinel injuries, defined as inflicted injuries that are minor and recognized by physicians or parents before the recognition that the child has been abused, are common in abused infants but rare in those not abused.[54] For example, previous sentinel injuries are identified in 25% of abused infants and in one-third of those with AHT.[54,55] The majority of sentinel injuries are bruises, intraoral injuries, including frena tears, or fractures.[57–60]

Physicians sometimes underappreciate the significance of sentinel injuries or attribute them to noninflicted trauma, self-inflicted trauma, or medical disease.[54] Physicians may overlook injuries that are commonly considered accidental in ambulatory children but have higher specificity for abuse in young infants. Radiographs and other imaging, ordered for possible injury or for other complaints, may be misinterpreted, missing signs of trauma that are subtle or unique to the infant brain or skeleton.[61,62] When sentinel injuries raise the concern of abuse, the physician may be falsely reassured by a negative evaluation for additional occult injuries. Physicians may correctly identify an injury as suspicious but decide not to report their suspicion to child welfare for investigation.[63,64] CPS may fail to put in place adequate protection for children after suspected abuse is reported.[54] All of these factors contribute to increased morbidity and mortality for physically abused children.

CLINICAL PRESENTATIONS AND SETTINGS

Infants and children who have been abused may come to a pediatrician's attention in a variety of ways. An individual (mandated reporter or other adult) may identify and report a suspicious injury; individuals may report an abusive event they witnessed; a caregiver may observe symptoms related to an injury and bring the child for medical care but may be unaware that the child has been injured; a child or adolescent may disclose that he or she has been hurt in an abusive manner; abusers may seek medical attention because they believe an injury is severe.

The clinical approach to an infant or child with possible abusive injuries does not differ significantly from routine pediatric care. Abused children can present with a range of injuries, from minor to life-threatening. As with all patients, a severely injured child needs to be stabilized before further evaluation is undertaken. This initial evaluation may require a trauma response team and pediatric specialists in surgery, emergency medicine, and critical care. If the child presents to the pediatric office with a serious injury that requires further medical care in a specialty clinic or hospital setting, the physician may opt to gather the minimum information needed to report to CPS. Injuries suspicious for abuse or neglect are required by law to be reported to CPS. In many communities, especially those near academic pediatric centers, child abuse pediatricians are available for consultation and assistance with challenging cases, although as with other medical problems, many cases of maltreatment can be managed by the child's primary care pediatrician. The pediatrician may also refer the patient to a local community hospital to complete needed radiologic and laboratory evaluation. In some communities, hospital social workers are available to assist in making referrals to CPS. If a physician is suspicious that the patient was maltreated, transferring the child to another physician or facility for medical care does not relieve the physician of his or her responsibility as a mandated reporter of suspected abuse.

MEDICAL HISTORY

Once the child is stabilized, a careful and well-documented history is an important element of the medical evaluation. Parents or other responsible caregivers can be asked to describe in detail events surrounding all reported injuries. The best approach is to allow the parent or other caregiver to provide a narrative without interruptions, so that the history is not influenced by the clinician's questions or interpretations. Clarifying questions can then follow. At times, it may be clinically helpful to interview each parent separately, although this is often not possible in the office setting. Information about the child's behavior before, during, and after the injury occurred, including the day's activities, events leading up to the injury, feeding times, and level of responsiveness, are important to collect. In cases of abuse, the exact timing of an injury may not be known, and information about the child's activities and wellness leading up to the medical visit is needed. Knowing when a child was last noted to be normally active and well-appearing may assist with identifying the timing of an injury. If there is no history of trauma provided, the physician can specifically ask whether the child may have sustained any trauma, and denials are helpful to record in the medical record. It is important to document descriptions of the reported mechanism of injury or injuries, onset and progression of symptoms, and the child's developmental capabilities. Few pediatricians are trained in forensic interviewing, and it is not the physician's responsibility to identify

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the perpetrator of the abuse or the exact details of an abusive event, but to recognize potential abuse, obtain a thorough medical and event history, initiate appropriate workup, and then refer the patient or involve the specialists who are expert in completing the medical evaluation and/or investigation.

School-aged children and adolescents may not disclose their abuse, even when their injuries strongly indicate abusive trauma. They may be afraid of repercussions or have feelings of loyalty to their abuser. They may be fearful of being removed from their family home and want to stay at home despite personal danger. Routine inquiry about physical, sexual, and other safety during adolescent health care visits may improve disclosure of abuse, and providing privacy and interviewing adolescents alone when they present with concerning injuries is an important feature of the adolescent evaluation.

Victims of significant trauma usually have observable changes in behavior, although exceptions exist. In young infants, changes in behavior can be difficult to assess by both parents and physicians. For example, children's behaviors after fracturing a bone are variable; in a recent study of accidental fractures in children less than 6 years of age, a notable minority of children with long-bone fractures did not cry or use their affected limb abnormally after injury, causing some delay in the seeking medical care.[65] Children with fatal head injuries are usually comatose immediately after the injury. However, on rare occasions, young victims of fatal head trauma may present with some level of neurologic alertness, although not normal, before death.[66,67] Some victims of AHT may have nonspecific symptoms for several hours or more before developing either seizures or coma, and others can present with nonspecific symptoms. Such symptoms may include reduced activity, lethargy, irritability, poor feeding, vomiting, or apnea.[68,69] Documentation of historical details provided to the pediatrician can be important during later investigation of suspicious injuries.

Information can be gathered in a nonaccusatory but detailed manner. For example, asking the caregivers whether they have any concerns that someone might have harmed the child introduces a concern, without apportioning blame. Additional information that may be useful in the medical assessment of suspected physical abuse includes the following:

1. Standard history including medical, developmental, and social history;
2. Family history: especially of bleeding, bone disorders, and metabolic or genetic disorders;
3. Pregnancy history: wanted/unwanted, planned/unplanned, prenatal care, postnatal complications, postpartum depression, delivery in nonhospital settings;
4. Familial patterns of discipline;
5. Child temperament: whether the child is easy or difficult to care for; whether there is excessive crying in an infant; parents' expectations of the child's behaviors and development;
6. History of abuse to child, siblings, or parents and previous and/or present CPS involvement with the family;
7. Substance abuse by any caregivers or people living in the home; mental health problems of parents; past arrests, incarcerations, or interactions with law enforcement; and domestic violence (which may be necessary to ask of each parent or caregiver individually); and
8. Social and financial stressors and resources.

HISTORIES THAT SUGGEST CHILD ABUSE

Injuries are common in childhood; those sustained by ambulatory, active children are often unwitnessed by caregivers. In such cases, parents can describe events surrounding the injury, but are unable to describe the precise mechanism of trauma. Verbal children can often provide their own history of trauma, which can be helpful in the evaluation. If the child can be interviewed, his or her demeanor can be noted during questioning. Some abused children display strong nonverbal cues of anxiety and reluctance when answering questions regarding potential abuse, because they are protective of their abuser or they fear retribution for "telling." Others may appear openly fearful of their abuser. However, some children hide their fear and emotions remarkably well. Such responses may be important to consider when a safety plan for the child is made.

In addition to a disclosure of abuse from a child or parent, there are histories that raise a concern for abusive trauma. These include histories in which

1. There is either no explanation or a vague explanation given for a significant injury;
2. There is an explicit denial of trauma in a child with obvious injury;
3. An important detail of the explanation changes in a substantive way;
4. An explanation is provided that is inconsistent with the pattern, age, or severity of the injury or injuries;
5. An explanation is given that is inconsistent with the child's physical and/or developmental capabilities;
6. There is an unexplained or unexpected notable delay in seeking medical care; or
7. Different witnesses provide markedly different explanations for the injury or injuries.

PHYSICAL EXAMINATION

An injury pattern is rarely pathognomonic for abuse or accident

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without careful consideration of the explanation provided, a thorough physical examination, and radiographic or laboratory analysis. In cases of rare accidental household injury leading to a severe or fatal outcome, investigation into the cause of the injury is often necessary, and reporting the injury for investigation is still warranted. In many states, parental consent is not needed to photograph abusive injuries or obtain radiographs or other needed studies in cases of suspected abuse.

Child abuse is sometimes diagnosed when a child is brought for evaluation and treatment of a specific injury, but some abusive injuries may be uncovered unexpectedly during a routine physical examination or an examination done for another reason. When injuries are identified during an examination, it is appropriate to ask the child (or parent, if the child is preverbal) how the injury occurred, and if significant, whether the child was seen for treatment of the injury.

If child abuse is suspected, based on history or physical examination findings, a thorough examination with the child undressed (in a gown) is necessary. The general examination of the child may reveal evidence of neglect, including malnutrition, extensive dental caries, untreated diaper dermatitis, or neglected wound care. It is important to carefully measure and plot all growth measures on a growth chart, and obtaining previous measurements can help gauge whether the growth velocity has been appropriate. Plotting growth parameters is important, because clinicians may miss significant growth failure in infants and children if the clinician relies only on clinical impression. Physical abuse and neglect are sometimes concurrent, and on occasion, children may be intentionally starved.[70,71] The head, eyes, ears, nose, and throat (HEENT) examination includes an inspection of the scalp for traumatic wounds or traumatic alopecia. The mouth examination may reveal healing mucosal tears, dental trauma, or dental caries.[72,73] Careful examination of the frena in infants may reveal acute or healing injury. The skin examination may reveal bruises, lacerations, burns, bites, or other injuries that can be documented with the location, size, shape, and other details of the injury. Skin injury in unusual locations such as the pinna, the back of the ear, the hairline behind the ear, the buttocks, and thighs are seen in abused children and require attention during the physical examination. Adolescents may display defensive wounds on the hands, forearms, or other parts of the extremities, as they try to protect themselves from their abuser. Skin injuries can be documented in the medical record by written description, photograph, or both. The chest and abdomen may reveal injury, and a careful palpation of the legs, arms, feet, hands, ribs, and head may reveal acute or healing (callous) fractures. A complete neurologic assessment, including assessment of the anterior fontanelle, reflexes, cranial nerves, sensorium, and gross and fine motor abilities appropriate to the child's development and age, is important in the overall assessment. The child's alertness and demeanor may reflect the neurologic status and degree of discomfort and pain. Abnormalities may reflect current or past injuries to the central nervous system. Abused children may also have developmental disabilities because of deprivation in the home environment or other causes.

PHYSICAL EXAMINATION FINDINGS THAT SUGGEST ABUSE

Specific individual injuries and certain patterns of injury warrant careful consideration for abuse, although few single injuries are pathognomonic for abuse. Typically, the comparison of the provided mechanism, the age and development of the child, and the severity and age or timing of the injury will identify those that require further investigation for abuse. Additionally, there are diseases that can be mistaken for child abuse, and testing to identify diseases in the differential diagnosis is sometimes required.[74] In some cases, this will require consultation with pediatric subspecialists. General physical examination findings that suggest abuse include the following:

1. ANY injury to a young, pre-ambulatory infant, including bruises, mouth injuries, fractures, and intracranial or abdominal injury;
2. Injuries to multiple organ systems;
3. Multiple injuries in different stages of healing;
4. Patterned injuries;
5. Injuries to nonbony or other unusual locations, such as over the torso, ears, face, neck, or upper arms;
6. Significant injuries that are unexplained; and
7. Additional evidence of child neglect.

Skin Injuries

Bruises are the most common and readily visible injuries due to physical abuse but are missed as a sentinel injury in almost half of fatal and near-fatal abusive injuries.[54,63] Bruising may be the only external indicator of more serious internal injury.[75] There is ample evidence that evaluating bruising patterns in abused and nonabused children helps to identify specific ages, locations, and patterns of bruising that are highly correlated with child abuse.[76–81]

In children with bruising related to normal activity, the prevalence and mean number of bruises increases with age, and the majority of preschool-aged and schoolchildren have accidental bruises.[82] The commonest sites of bruising in nonabused, ambulatory children are to the knees and shins, and the vast

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majority of normal bruises are over bony prominences, including the forehead.[82]

Overall bruising patterns in abused children differ from those in nonabused children. The head and face are the most common sites of bruising in abused children,[83] and abused children tend to have more bruises identified at the time of diagnosis.[82] Abused children may have clustering of bruises, sometimes representing defensive injuries. Bruises may carry the imprint or negative image of an implement, such as seen with handprints or looped marks from extension cords. Bruises are notably rare in preambulatory infants. There is a strong correlation between bruising and mobility in infants and toddlers, and any bruising identified in a nonambulatory infant requires careful consideration and medical evaluation for possible abuse: "those who don't cruise, rarely bruise."[78] All parts of the body are vulnerable to bruising from abuse, and bruises to the torso, ears, or neck in children ≤4 years of age are predictive of abuse.[76] The mnemonic "TEN 4" is an easy way to identify bruises that are of concern for abuse:

T: torso;

E: ear;

N: neck; and

4: in children less than or equal to 4 years of age and in ANY infant under 4 months of age.

The age of a bruise cannot be determined accurately.[84] Deep bruises may not be readily visible for several hours or in some cases, a few days. Areas that are painful to palpation may require repeat examination in 1 to 2 days, when the bruise may become apparent. Soft tissue swelling is associated with recent trauma and can persist for several days.

Many diseases are associated with bruises, including coagulopathies and vasculitides, and children who present with suspicious bruises may require screening for diseases that are included in the differential diagnosis of abuse. Additional discussion related to the evaluation of bleeding disorders in suspected child abuse can be found in the recently published AAP clinical and technical reports.[85,86]

Bite marks can be important evidence in cases of suspected child abuse. Bite marks are characterized by ecchymoses, abrasions, or lacerations that are found in an elliptical or ovoid pattern. Bite marks may have a central area of ecchymosis caused by either positive pressure from the closing of the teeth with disruption of small vessels or negative pressure caused by suction and tongue thrusting.[87] Bite marks can be inflicted by an adult, another child, an animal, or the patient. Identifying the perpetrator is determined by size, dentition characteristics within the wound, location of the wound, presence of puncture marks, arch form, and intercuspid distance. All of these characteristics may or may not be found in every bite mark. Dental professionals are invaluable resources for identifying wound patterns suspicious for bites. When in doubt, health care professionals may seek the advice of a dentist or forensic odontologist, if available, to assist in the evaluation. Photographing bite marks requires special techniques and resources and is not part of routine pediatric practice. For those who have access to professional medical photographers, multiple color photos, all including a known color and measurement index and taken perpendicular to each body plane, can be taken by using various exposures to facilitate adequate evidence collection. If a standard index, such as the American Board of Forensic Odontology No. 2 scale, is not available, any indexing item of known size and shape, such as a quarter or other coin, can be a suitable index for processing and analysis. Swabs of a fresh bite can be sent to a crime laboratory for DNA analysis, something occasionally done in the emergency department.

Although burns are common childhood injuries, only a minority are associated with abuse. Inflicted burns tend to be more severe, in part because they are often associated with delay in seeking medical care, and are more common in young children.[88] Scald burns, including immersions, are the most common cause of severe burns requiring hospitalization in children. Inflicted immersion burns characteristically have sharp lines of demarcation and often involve the genitals and the lower extremities in symmetric distributions.[89] These burns are often associated with soiling accidents or other behaviors that require cleaning the child and are seen most often in toddlers. Object contact burns are inflicted with hot solids, such as irons, radiators, stoves, or cigarettes. Burns inflicted with hot objects can be difficult to differentiate from accidental mechanisms, because both may be patterned, but inflicted contact burns are characteristically deep and leave a clear imprint of the hot instrument. The history, number of burns, and continuity of the burn pattern over curved body surfaces may indicate a greater probability of inflicted injury. Dermatologic and infectious diseases can mimic abusive burns, including toxin-mediated staphylococcal and streptococcal infections, impetigo, phytophotodermatitis, and chemical burns of the buttocks from senna-containing laxatives.[90] Inflicted burn injuries require the same treatment as any burn, but children with inflicted burns have a higher morbidity and longer hospital stays than children with accidental burns.[91]

Skeletal Injuries

Most fractures in childhood are the result of accidental trauma, and of the small percentage of fractures that result from abuse, most are found in infants.[92–94] Abused infants and

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children may present with skeletal trauma as their sentinel injury, and fractures are regularly identified by skeletal radiographs during the medical evaluation of suspected abuse as well as other conditions. The timely identification of skeletal injury can lead to earlier identification of abuse, sparing the victim further injury, which sometimes can be life-threatening.[62] Children with recent fractures are usually symptomatic, with crying, visible swelling, or refusal to use the affected area. On occasion, the child's symptoms are minimal, which can lead to a delay in seeking care.[65] When fractures are suspected, skin surfaces can be carefully examined for 'grab marks' that may indicate restraint or areas that were pulled or twisted to create the fracture. Absence of such bruising does not exclude a fracture or an abusive mechanism of injury. In fact, most fractures sustained by healthy children are not associated with bruising either at the time of presentation (only 10% with bruising) or within the first week (28% with bruising) after trauma.[95] Abusive fractures have been described in virtually every bone in the body, and any single fracture can be the result of accident or abuse. Skull fractures are common injuries in nonabused infants, and parietal and linear skull fractures are most common in both abuse and nonabuse.[96,97] Physical abuse is in the differential diagnosis for children with fractures in the following situations:

1. Fracture(s) in nonambulatory infants, especially in those without a clear history of trauma or a known medical condition that predisposes to bone fragility;
2. Children with multiple fractures;
3. Infants and children with rib fractures;
4. Infants and toddlers with midshaft humerus or femur fractures;
5. Infants and children with unusual fractures, including those of the scapula, classic metaphyseal lesions (CMLs) of the long bones, vertebrae, and sternum, unless explained by a known history of severe trauma or underlying bone disorder; and
6. The history of trauma does not explain the resultant fracture.

Some fractures in abused children, including rib fractures and CMLs, may not be clinically detectable, and a negative clinical examination does not preclude the need for a skeletal radiologic survey when inflicted trauma is suspected, particularly in children younger than 2 years.

Radiographic skeletal survey is the standard tool for detecting clinically unsuspected fractures in possible victims of child abuse (Table 2), and skeletal surveys should conform to American College of Radiology standards.[98] A recent analysis of more than 700 consecutive skeletal surveys performed at 1 children's hospital revealed occult skeletal trauma in 11% of those tested, influencing the diagnosis of abuse in more than half of the positive cases.[99] Race and socioeconomic status appear to influence a physician's practice in obtaining skeletal surveys when children present with skeletal trauma, leading to both over- and underreporting of abuse in different populations.[36,100] Repeating skeletal surveys 2 to 3 weeks after an initial presentation of suspected abuse improves diagnostic sensitivity and specificity for identifying skeletal trauma in abused infants.[101,102] Not all abusive fractures (eg, rib fractures and CMLs) are visible by radiograph initially, and prospective studies have shown that repeat skeletal imaging increases the number of fractures diagnosed by more than 25% in abuse victims.[101] Repeat skeletal surveys can identify fractures not visible on initial skeletal survey, assist in dating of injuries, clarify questionable findings, and alter the clinical diagnosis in equivocal cases.

TABLE 2 Indications for Obtaining a Skeletal Survey

All children <2 y with obvious abusive injuries
All children <2 y with any suspicious injury, including
Bruises or other skin injuries in nonambulatory infants;
Oral injuries in nonambulatory infants; and
Injuries not consistent with the history provided
Infants with unexplained, unexpected sudden death (consult with medical examiner/coroner first)
Infants and young toddlers with unexplained intracranial injuries, including hemorrhage and hypoxic-ischemic injury
Infants and siblings <2 y and household contacts of an abused child
Twins of abused infants and toddlers

Diseases and conditions that affect collagen and/or bone mineralization can be included in the differential diagnosis of skeletal trauma due to abuse; identifying these diseases or conditions reduces false accusations of abuse.[103] Vitamin and mineral deficiencies and genetic and infectious diseases may be considered in the differential diagnosis when appropriate.[104–107] Additional discussion related to the differential diagnosis of fractures and fracture evaluation in suspected child abuse can be found in the recently published AAP clinical report.[108]

Thoracoabdominal Injuries

Injuries to the chest are common in abuse, although clinically significant internal organ injury occurs less frequently. Most thoracic injuries are due to blows or crush injury to the chest and/or abdomen. Abusive injuries that involve the heart, including direct cardiac trauma and dysrhythmias, are rare. Commotio cordis, hemopericardium, myocardial contusions, and cardiac aneurysms and rupture have all been reported from abuse, as has shearing of the thoracic duct resulting in chylothorax.[109–113] Pulmonary injuries in abused children include contusions, lacerations resulting in pneumothorax, hemorrhagic effusions or pneumomediastinum, and pulmonary edema associated with suffocation or head

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trauma.[114,115] Rib fractures are strongly associated with physical abuse.[92] They are usually due to forceful squeezing of the chest, are often multiple, can be unilateral or bilateral, and can occur anywhere along the rib's arc.[94,116] Acute rib fractures may be associated with shallow breathing attributable to pain and splinting, or with irritability when the infant is picked up and moved. Acute rib fractures can be difficult to identify radiographically, and both oblique views of the ribs and follow-up skeletal surveys done 2 to 3 weeks after an initial evaluation increase the identification of inflicted rib fractures. Rib fractures in infants can be related to osteopenia of prematurity or other metabolic bone disease, and careful clinical correlation is always required.[117,118] Although cardiopulmonary resuscitation (CPR) remains an unusual cause of rib fractures,[119] changes in CPR technique in the past few years may increase the risk of anterior and lateral rib fractures from CPR in infants.[120,121]

Abdominal injury is a severe form of maltreatment and represents the second leading cause of mortality from physical abuse.[122] The highest rates of abusive abdominal trauma are seen in infants and toddlers.[123] Compared with children who sustain accidental abdominal trauma, victims of abuse tend to be younger, are more likely to have an injury to the hollow viscera, are more likely to have delayed presentations to medical care, and have a higher mortality rate.[124,125] Solid organ injuries, most often involving the liver, are more common overall in both accidental and abusive abdominal injury, but abused children are more likely to have accompanying hollow viscus injury.[124] Abdominal bruising often is not seen, even in children with severe or fatal abdominal injury.[126] Symptomatic children can present with signs of hemorrhage or peritonitis, but many children will not display overt findings, or their abdominal trauma may be masked by other injuries. Screening laboratory tests, including liver and pancreatic enzyme levels, are important to obtain in all children who present with serious trauma, even if they do not display acute abdominal symptoms.[127,128] A urinalysis may also identify trauma to the urinary tract and kidneys. Radiographic studies, especially contrast-enhancing computed tomography (CT), are helpful in determining the types and severity of intra-abdominal trauma and are warranted when screening laboratory tests indicate possible abdominal trauma, in all cases of symptomatic injury, and most cases when the physical examination is unreliable because of the patient's age, presence of other injuries that may obfuscate the abdominal examination, or presence of accompanying head injury. Surgical consultation is required for children with inflicted abdominal injury.[114]

Head Injuries

Head trauma is the leading cause of child physical abuse fatality and occurs most commonly in infants.[129] Most fatal head injuries in infants and young children are the result of abuse.[130] Children with AHT may present for medical care with a false history of accidental trauma or with nonspecific symptoms related to their injuries. Several factors contribute to missed opportunities for AHT detection[55]: caregivers do not or cannot provide an accurate history of the injury to the physician, the presenting symptoms can be mild and nonspecific, and young infants are difficult to evaluate clinically, which makes accurate diagnosis impossible in some cases. On occasion, minor head injuries such as bruising or abrasions are discounted by physicians, developing macrocephaly goes unnoticed, or radiographs are misinterpreted. Racial and social biases may also contribute to misdiagnosis. Common erroneous diagnoses given to victims of AHT include viral gastroenteritis, gastroesophageal reflux, colic, accidental head injury, and otitis media.[55]

Multiple mechanisms contribute to the cerebral, spinal, and cranial injuries that result from inflicted head injury to infants and young children, including both shaking and blunt impact.[131] Confessions from some perpetrators have highlighted the often repetitive nature of the abuse, and the crying of an infant as a common impetus for the violence.[69,132] Compared with children with severe accidental trauma, children with AHT are more likely to have subdural hemorrhage, retinal hemorrhages, and associated cutaneous, skeletal, and visceral injuries.[97,133–136] Inflicted injuries tend to occur in younger patients and result in higher mortality and longer hospital stays than does accidental head trauma.[97,129,137] Infants with intracranial injuries may have no neurologic symptoms and are sometimes identified during a medical evaluation for other suspicious injuries.[75,138] Because the potential morbidity of AHT is so great, infants who are being evaluated for abuse benefit from brain imaging, whether or not they have neurologic symptoms.

All infants and children with suspected AHT require cranial CT, MRI, or both.[139] For symptomatic children, CT of the head will identify abnormalities that require immediate surgical intervention and is preferred over MRI for identifying acute hemorrhage and skull fractures and scalp swelling from blunt injury. MRI is the optimal modality for assessing intracranial injury, including cerebral hypoxia and ischemia, and is used for all children with abnormal CT scans, asymptomatic infants with noncranial abusive injuries, and for follow-up of identified trauma.[140,141] Ultrasound is often used in the initial evaluation of macrocephaly in young infants and can identify large extra-axial

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cerebrospinal fluid collections. Any abnormal ultrasound study requires more sophisticated follow-up with MRI. Ultrasound is not sensitive for identifying small subdural collections and is not the test of choice in the emergency setting.

Retinal hemorrhages are common, but not universal, in victims of AHT.[142] Although seen on occasion in children with accidental injury, severe retinal hemorrhages are highly associated with abuse, particularly in young infants.[143] The extent and severity of retinal hemorrhages are also greater in abuse victims and correlate with the severity of acute neurologic symptoms.[136,144] Retinal hemorrhages are occasionally identified in nonabused critically ill children, primarily those with coagulopathy, leukemia, or severe accidental injury, and are distinguished from abuse by history and laboratory testing.[145,146] An examination by using indirect ophthalmoscopy is required in the evaluation of AHT, preferably by an ophthalmologist with pediatric or retinal experience. The ophthalmologist can provide documentation of the retinal hemorrhages by photography or detailed annotated drawings. Location, depth, and extent of retinal hemorrhages may distinguish between abusive and nonabusive causes of head trauma.[147] Hemorrhages that extend to the ora serrata and involve multiple layers of the retina are strongly associated with AHT. A fundoscopic examination is not an adequate screening test for intracranial findings, as neurologically asymptomatic infants rarely have retinal hemorrhages but may, in fact, have intracranial injury. Recent studies suggest that fundoscopic examination may not be necessary if examination and neuroimaging show no evidence of intracranial injury, since the likelihood of encountering retinal hemorrhages in those children is very low.[75,148]

Conditions that may be confused with AHT include accidental trauma; metabolic, genetic, and other diseases that are associated with vasculitis, coagulation defects, or cerebral atrophy; and primary coagulopathies.[149] Although most household trauma results in minor or no injury, on rare occasion, severe or fatal head injury has been reported.[53] In addition to searching for occult trauma in patients who present with such a history, or in infants and young children who present with unexplained intracranial hemorrhage and/or hypoxic ischemic cerebral injury, consideration of alternate explanations is often required. Investigation by child welfare or law enforcement can also help to distinguish accidental from abusive head injury, and reporting to CPS for investigation in all suspicious cases is advised.

DIAGNOSTIC TESTING AND DOCUMENTATION

When abuse is suspected as the cause of an injury, the clinician may conduct tests to screen for other injuries and/or underlying medical causes that can contribute to the finding or be considered in the differential diagnosis of abuse. The extent of diagnostic testing depends on several factors, including the severity of the injury, type of injury, and age and developmental level of the child. In general, the more severe the injury and younger the child, the more extensive is the need for diagnostic testing for other injuries. Table 3 is a summary of tests that may be used during a medical assessment for suspected abuse. Additionally, child abuse pediatricians and pediatric subspecialists can be consulted to assist with recommendations and questions.

When 1 child is identified as a suspected victim of abuse, siblings, other young children in the household, and other child contacts of the suspected abuser greatly benefit from being assessed for injuries in a timely manner.[150] This assessment is especially important for twins, who are at substantial risk of injury, including occult fractures. The extent of the assessment depends on the child's age, symptoms, and signs; infants and toddlers may require more extensive testing, because symptoms and signs may be less useful in determining the presence of occult abusive injuries. A skeletal survey is extremely useful for children <2 years of age who are siblings or other household members of abused children, as occult fractures are detected in more than 10% of these children.[150]

Thorough medical documentation of the reported history and physical examination findings can be crucial to protecting and intervening early with children suspected of being abused. Careful documentation of visible injuries by written description, digital photographs, and/or body diagrams facilitates peer review as well as court testimony, when required. In some regions, investigators from law enforcement or CPS are trained to take forensic photographs. It is important to include diagnostic impressions in the medical record that address the likelihood of nonaccidental injury when child abuse is suspected. In cases with multiorgan, severe, or obvious injuries, abuse may be clear, and a strong diagnostic statement is warranted. Some injuries, while suspicious, are less diagnostic and may warrant further medical evaluation by a child abuse pediatrician, a specialist in pediatric radiology, neurology, orthopedics, surgery, or other specialties, and/or a CPS investigation. Medical records that reflect specific levels of concern, alternative diagnostic possibilities, and include the results of additional testing are important for later review and to assist CPS or police investigation. It is helpful to document reports to CPS and law enforcement in the medical record. If

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TABLE 3 Diagnostic Tests That May Be Used in the Medical Assessment of Suspected Physical Abuse and Differential Diagnoses[a]

Type of Injury or Condition	Laboratory Testing	Radiologic Testing	Comments
Fractures[108]	• Bone health laboratory testing, including calcium, phosphorus, alkaline phosphatase • Consider 25-hydroxyvitamin D and PTH level • Consider serum copper, Vitamin C, and ceruloplasmin levels if child is at risk for scurvy or copper deficiency • Consider skin biopsy for fibroblast culture and/or venous blood for DNA analysis for osteogenesis imperfecta	Skeletal survey	• Repeat skeletal survey in 2 wk for high-risk cases • Single whole-body films are unacceptable • Bone scintigraphy may be used to complement the skeletal survey
Bruises[85,86]	Tests for hematologic disorders: CBC, platelets, PT, INR, aPTT, VWF antigen, VWF activity (ristocetin cofactor), factor VIII level, factor IX level	• Skeletal survey for nonambulatory infants with bruises and for infants and toddlers with suspicious bruising • Brain imaging for infants with suspicious bruising.	• Useful when bleeding disorder is a concern because of clinical presentation or family history • Consultation with pediatric hematologist for any abnormal screen or other concern
Abdominal trauma	• Liver enzyme tests: aspartate aminotransferase, alanine aminotransferase • Pancreatic enzymes: amylase, lipase; urinalysis	• CT of abdomen with contrast • Skeletal survey in children <2 y	• Screening abdominal laboratory tests are helpful in diagnosing occult abdominal injury in young abuse victims • IV contrast should be used for CT scan and is preferable to PO[135]
Head trauma	• CBC with platelets, PT/INR/aPTT; factor VIII level, factor IX level, fibrinogen, d-dimer • Review newborn screen • Consider urine organic acids to screen for GA1	• CT scan: head[b] • MRI of head and spine • Skeletal survey	• MRI may provide better dating of intracranial injuries than CT • MRI more sensitive than CT for subtle intracranial injuries in patients with normal CT and abnormal neurologic examinations • Diffusion-weighted imaging may show extent of parenchymal injury early in course • MRI more sensitive than plain radiographs and CT for detecting cervical spine fractures/injury • CT, and three-dimensional spiral CT enhance detection of skull fractures
Cardiac injury	Cardiac enzymes: troponin, creatine kinase with muscle and brain subunits (CK-MB); troponin		

aPTT, activated partial thromboplastin time; CBC, complete blood cell count; CK-MB, creatine kinase MB band; GA1, glutaric aciduria type I; INR, international normalized ratio; IV, intravenous; PO, oral; PT, prothrombin time; PTH, parathyroid hormone; VWF, von Willebrand factor.

[a] Tests can be ordered judiciously and in consultation with the appropriate genetics, hematology, radiology, and child abuse specialists. Careful consideration of the patient's history, age, and clinical findings guide selection of the appropriate tests.

[b] CT scan may provide clinically relevant information more expeditiously than MRI in some facilities.

a child has sustained a serious injury because he or she was left unsupervised in a dangerous environment, the physician can report suspected neglect or inappropriate adult supervision to CPS; this includes injuries sustained while under the care of an intoxicated adult.[151]

TREATMENT

Once medical assessment and stabilization are achieved and a report has been made to investigative agencies, the physician can continue to be an advocate for the child, helping to see that the child receives necessary follow-up services. The child's primary care physician, if not already involved, should be notified, and CPS can assist the family in complying with the plan of care. These services may include referral not only to appropriate medical providers but also often to mental health providers for an evaluation because of the psychological effect of abuse or neglect on the young child, the siblings, and the nonoffending caregiver. Because adult intimate partner violence, drug abuse, and other adult stressors commonly co-occur with child abuse, family members may require timely medical and mental health assistance.

THE ROLE OF THE PEDIATRICIAN

Pediatricians are in a unique position to recognize abuse and protect victims, especially young children,

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children with disabilities, and other children who are isolated in some way from regular contact with the public. The management of child abuse is one of the most challenging and unsettling responsibilities in pediatric practice, and pediatricians often struggle to balance their roles as family and child advocates.[63,64] Child abuse is common, however, and the morbidity significant, which is why identifying, promptly reporting, and managing cases of suspected abuse can be so important to the health and safety of children.

Duty to Report Child Abuse

This report has provided a general overview of child physical abuse. As with all medical diagnoses, successful management begins with awareness and attention to detail in clinical practice. When the history or physical examination reveals suspicious injuries, and the pediatrician has a reasonable suspicion that a child has been abused, a report to CPS for further investigation is mandated by law. Mandatory reporting laws do not require certainty, and failure to make a report can result in civil or criminal penalties for the physician, or most dire, additional injury or death of a child.[49] All state laws provide some type of immunity for good-faith reporting, although laws vary slightly between states. Many states have laws that permit physicians to evaluate children who are suspected victims of abuse, to conduct tests, and to take photographs of children's injuries without parental consent. In practice, parents are informed of testing, radiographs, and photographs that will be taken, and parental refusal is uncommon. Pediatricians can look to specific state laws for additional guidance if these issues arise.

Child abuse cases can be difficult to evaluate, and input from a trusted colleague, senior clinician, or medical specialists can be helpful. If the pediatrician is uncertain about whether to report a suspicion to CPS, consultation with pediatric specialists in child abuse, radiology, orthopedics, neurology, surgery, and other specialties can be a valuable resource. Arranging hospitalization for a child who requires additional medical testing and/or protection is often required, allows for additional consultation and observation, and should be considered medically necessary by third-party payers.

Many hospitals and communities have developed teams of child abuse pediatricians and other professionals who specialize in the assessment of suspected abuse.[152] Involving such teams early in the process can improve accurate and comprehensive assessments and information sharing among the medical and nonmedical disciplines involved.[153] Other regions do not have specialized child abuse teams, but do have physicians with expertise in child abuse.

Once the decision has been made to report a concern of physical abuse to CPS, it is important to discuss the report with the child's parent(s). This is one of the most difficult discussions a pediatrician may have in clinical practice, but an honest conversation will allow for more open communication during and after the ensuing investigation. In this conversation, it can be helpful to raise concern about an injury, while not apportioning blame, and inform the parent that because of the nature and circumstances of the injury, a report for further investigation is mandated by law. Although some families may abandon the pediatrician's practice after a report is made, it is important not to abandon the family at the time of the report. An investigation of possible abuse is a time of crisis for a family, and a supportive physician can be of great assistance to the child and nonoffending parent(s) and family members. In addition, most cases of child physical abuse result from family stress, and state CPS agencies typically provide useful family support in these cases. These supports may range from day care vouchers to in-home therapy. Only a minority of children reported to CPS enter the foster care system, and these cases are carefully overseen by the court system. Thus, it is rare that a physician report alone leads to removal of children from their biological parents.

The physician's cooperation with CPS investigations is necessary to improve decision-making by investigators. Health Insurance Portability and Accountability Act (HIPAA) rules allow disclosure of protected health information to CPS without legal guardian authorization when the physician has made a mandatory report, but state laws differ regarding the release of health information to investigators under other circumstances and after investigations are complete.[154] Because CPS and law enforcement investigators do not typically have a medical background or training, the pediatrician's interpretation of the child's injuries in straightforward language that allows for a meaningful conversation with the investigators is needed for proper investigation, decision-making, and protection of the child. The physician may be required to write a summary statement of his or her findings and to testify in civil or criminal trial proceedings. Additional information on testifying in civil and criminal legal proceedings can be found in an AAP policy statement on the subject.[155]

Prevention

Child abuse prevention is important but difficult and requires efforts that are broad and sustained. The pediatrician, as a trusted advisor to parents, caregivers, and families about health, development, and discipline, can play an important role in abuse prevention by assessing caregivers' strengths and deficits, providing education to enhance parenting skills, connecting families with supportive community resources that address parent and

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family needs, and promoting evidence-based parenting practices that are nurturing and positive.[34] Pediatricians can serve as effective advocates for funding and implementation of evidence-based prevention programs in their communities, as well as at the state and national level. Pediatricians can also partner with home-visiting and parenting programs in their community. Finally, recognizing abuse and intervening on behalf of an abused child can save a life and can protect a vulnerable child from a lifetime of negative consequences.

SUMMARY

To protect children who are victims of physical abuse,

1. Pediatricians can be alert for injuries that raise suspicion of abuse but may be overlooked by unsuspecting physicians, including
   a. ANY injury to a nonmobile infant, including bruises, oral injuries, or fractures;
   b. Injuries in unusual locations, such as over the torso, ears or neck;
   c. Patterned injuries;
   d. Injuries to multiple organ systems;
   e. Multiple injuries in different stages of healing; and
   f. Significant injuries that are unexplained.
2. Pediatricians can consider the possibility of trauma in young infants who present with nonspecific symptoms of possible head trauma, including unexplained vomiting, lethargy, irritability, apnea, or seizures, and consider head imaging in their evaluation.
3. A skeletal survey for any child <2 years old with suspicious injuries can identify occult injuries that may exist in abused children and is very useful in the evaluation of suspected abuse.
4. Brain imaging may identify injury in abused infants, even in those who are not overtly symptomatic.
5. Examining siblings and household contacts of abused children often reveals injuries to those children; those under 2 years old benefit from a skeletal survey.
6. Consultation with colleagues, child abuse pediatricians, and other pediatric specialists to assist in the evaluation of difficult cases is very helpful.
7. Pediatricians are mandated reporters of suspected abuse, and reports to CPS are required by law when the physician has a reasonable suspicion of abuse. Transferring a child's care to another physician or hospital does not relieve the pediatrician of his or her reporting responsibilities.
8. Pediatricians may need to hospitalize children with suspicious injuries for medical evaluation, treatment, and/or protection.
9. Thorough documentation in medical records and effective communication with nonmedical investigators in child protection may improve outcomes of investigations and protect vulnerable children.

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Pediatrics; originally published online April 27, 2015;
DOI: 10.1542/peds.2015-0356

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Pediatrics; originally published online April 27, 2015;
DOI: 10.1542/peds.2015-0356

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