Chadwick's

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Child Maltreatment

Physical Abuse and Neglect

Encyclopedic Volume 1 of 3
Fourth Edition

STM **Learning**, Inc.
Leading Publisher of Scientific, Technical, and Medical Educational Resources
Saint Louis
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To Jim Hmurovich, President and CEO of Prevent Child Abuse America,
who I have come to know as an effective child and family advocate
who leads by example and makes the case everywhere he can
that prevention of child abuse and neglect is possible and our collective responsibility.
— APG —

To David Chadwick, Henry Kempe, Ray Helfer, Robert Reece,
Jay Whitworth, and the other pioneers of child abuse advocacy
for deeply caring about children in a world that sometimes does not care as well as it should.
— RA —

"Every day counts in the life of a child." Thanks for the support from our families, friends, and colleagues.
— DEJ —

To my family for your patience, my colleagues for your acceptance and to all those
who have left the world a bit better, and made so many little lives breathe easier - this is to have succeeded.
— JT —

CHADWICK'S

CHILD MALTREATMENT

PHYSICAL ABUSE AND NEGLECT

ENCYCLOPEDIC VOLUME 1 OF 3
FOURTH EDITION

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Foreword

An impressive group of medical and mental health investigators, lawyers, child protection agency personnel, and clinicians has combined their talents to produce this comprehensive text on all aspects of child abuse and neglect. This milestone achievement is the latest book in this field that began in 1964. That was the year that Vincent J. Fontana and Douglas J. Besharov published *The Maltreated Child: The Maltreatment Syndrome in Children: A Medical, Legal and Social Guide.* In 1968, Ray E. Helfer and C. Henry Kempe edited the first edition of *The Battered Child*. Norman S. Ellerstein published the first edition of *Child Abuse and Neglect: A Medical Reference* in 1981 and in 1982 Eli H. Newberger edited the book entitled *Child Abuse.* In 1989 Lawrence Wissow singlehandedly wrote his book *Child Advocacy for the Clinician*. *Child Abuse and Neglect: A Medical Reference* (second edition), edited by Stephen Ludwig and Allan Kornberg, was published in 1992. James A. Monteleone published *Child Maltreatment* in 1994 and the first edition of *Child Abuse: Medical Diagnosis and Treatment,* edited by Robert M. Reece, was published in that same year.

Glenn Whaley, the publisher of Dr. Monteleone's original book, said that his book began as "a 60-page manuscript that he and Dr. Brodeur wanted to publish with the title of *Tears That Never Dry*." Because of this manuscript Whaley became more conscious of the phenomenon of child abuse and saw the need for current science to inform physicians, "as they were not familiar with what to look for in identifying or interpreting child abuse." He decided to produce a more comprehensive set of books with a clinical text and atlas for all mandated reporters with Dr. Monteleone. "Dr. Monteleone provided a general table of contents, selected contributors and helped with identifying others to produce chapters." Dr. Monteleone dictated his chapters to Ms. Elaine Steinborn, GW's developmental editor, who transcribed "his notes and scribbles on napkins" into the first edition of Child Maltreatment, published in 1994. Subsequent editions, edited by Giardino and Alexander, have retained some of the most timeless images Dr. Monteleone contributed in the early works, while adding the latest in current research findings as they became available. The fourth edition builds upon Dr. Monteleone's work with more than 660 new images in the field of child maltreatment.

Before 1964 there were no medical texts devoted exclusively to child abuse and neglect. By 2013 there are countless books, manuals, CDs, DVDs and videos available to clinicians who diagnose and treat this significant cause of morbidity and mortality in children. A new subspecialty, Child Abuse Pediatrics, now exists and Fellowship programs are available in numerous advanced medical centers. Sadly, the incidence of child maltreatment has not been reduced to the degree that we can say we have overcome the problem. Indeed, the incidence figures have hardly budged and many medical clinicians opine – with no real data, but with much clinical experience – that the severity of cases seems to be getting worse.

Textbooks alone cannot solve the problem of child maltreatment. Only good clinicians and support of proven prevention strategies can move the field in that direction. But textbooks are still essential tools for education and consultation. William Osler said at the turn of the 20th century, "To study the phenomena of disease without books is to sail an uncharted sea." This book will help chart the course in the turbulent seas of child abuse and neglect diagnosis and management in hospitals, clinics, communities, and courts so that we can continue to pursue the goal of reducing this scourge. It is our responsibility to combine the knowledge in these books with a caring and analytical approach to patients and families.

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Foreword

The child maltreatment field has evolved dramatically over the past fifty years, with each new innovation building on the contributions of professionals who have endeavored to create a better world for children. It is noteworthy that this volume has been renamed for one of the visionary leaders in the field, Dr. David Chadwick, and everyone who reads and utilizes this valuable collection of work written by more than 40 experts in the field is benefitting from not only their expertise, but also the expertise of the countless dedicated professionals who were colleagues of Dr. Chadwick.

We must now view child maltreatment as more than a dedicated field of work to improve the lives of children – in a larger frame the professionals working in this field are daily working to improve the health and well-being of our world as the children we serve today will be those who will shape the future generations. Thus, this incredible collection of knowledge and resources should be viewed more expansively as a blueprint for achieving this broader goal, with guidance from wise and esteemed leaders in the field.

The multidisciplinary response to child maltreatment and awareness of the valuable contributions made by each of these disciplines is critical for an effective response to child maltreatment. Initial multidisciplinary efforts involved a limited number of professions, and we are now in an era where additional professional fields are becoming involved in this expanding multidisciplinary response to child maltreatment. This volume includes topics of dramatic importance for those working in the child maltreatment field and builds on the existing knowledge and practice base to assist professionals in the child maltreatment field to be more effective in their daily work. These outstanding contributions, in addition to updated chapters on critical topics make this volume an incredibly valuable and authoritative text that succinctly applies the knowledge gained from existing research and case studies to the direct practice for those working in the field.

The child maltreatment field, buoyed by the continued revision of these volumes, has been propelled from a practice of best efforts to a more evidence-based and evidence-informed practice which is leading to better outcomes for children and our society. Aside from being an outstanding compilation of existing knowledge related to child maltreatment prevention and intervention, these volumes also serve as a motivator for readers to promote improved practice and further evolution of the entire field.

The multidisciplinary response and value is not measured in comparison to each involved discipline. It is measured in the combined positive impact this collaboration has for each child and family served. The newly revised Fourth Edition of *Chadwick's Child Maltreatment* provides the necessary guidance for allied professionals to provide their services in a most effective manner while also increasing their understanding of their multidisciplinary partners; and this approach will continue to bring the change desired by all those who accept the challenge of child protection and well-being.

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Preface

Poverty, young parents, the use of corporal punishment, intimate partner violence and substance abuse are known risk factors for physical abuse and neglect. Fang has estimated that for 2008, the estimated annual cost of child abuse and neglect in the US is $124 billion dollars. This may be a significant underestimate.

In Jonathan Swift's *A Modest Proposal,* the author recommends that in order to deal with the plight of poor Irish children, some of them should be eaten, "*…young healthy well nursed is at a year old a most delicious, nourishing, and wholesome food…"* At first reading of this essay, one would be horrified at such a suggestion. However, his satirical piece was meant to bring attention to the actual socioeconomic environment of children in Ireland in the 1700s. There were too many children born into poverty who were often malnourished and neglected, forced to beg, or sold into slavery when they reached age twelve.

Fast forward several hundred years and examine the socioeconomic status of children in the United States today. In 2010, according to the US Census Bureau, 16.4 million or 22% of the nation's children were poor. More than 1 out of every 5 children resides in households where the pre-tax income is below the poverty threshold. There is no doubt that poverty contributes to child maltreatment. Child abuse and neglect occurs at significantly higher rates among the poor.

Both the US Department of Health and Human Services (NCANDS) and the National Incidence Study of Child Abuse and Neglect (NIS–4) report maltreatment is decreasing. Yet this may be misleading. Recently, the rate of abusive head trauma (AHT), the most serious and deadly form of physical abuse, increased significantly in 3 geographic US regions during a one and a half year economic recession. Whether decreasing or increasing, the number of maltreated children is staggering. In 2011, more than 675 000 children were substantiated as victims of abuse and neglect, or 9.1 victims per 1000 children in the population according to child protective services numbers. There were over 3 million referrals. Thus, referrals that are not substantiated do not mean that abuse has not occurred. Through surveys such as the ACEs study, it is known that perhaps half of the adult population has been the victim of some sort of abuse. This means that child protection services see only a fraction of all abuse and that children suffer most abuse silently during their childhood.

More than 75% of maltreated US child victims suffered substantiated neglect and more than 15% suffered physical abuse in 2011. A parent acting alone or with someone else maltreated 4/5 of victims. A mother acting alone maltreated 2/5 of victims. It really is no surprise that many of the perpetrators were young, 40.8% less than 29 years old. According to the CDC, there were 367 752 infants born to 15-19 years olds in 2010. But more concerning was repeat births to teen mothers – 65 770 teens with a second child and 11 056 teens with a third child. Young, single mothers are at risk for maltreating their children. They themselves may have been victims of abuse; they may be uneducated or ill-prepared for the necessary skills required to provide a safe and nurturing environment. They also may have become pregnant due to coercion or birth control sabotage by an intimate partner.

More than 25% of maltreated children had an intimate partner violence (IPV) risk factor. Children do not have to be present to suffer the consequences. They can see the aftermath of an argument such as parental injuries or destruction of property. Children in households with IPV are significantly more likely to be physically abused. They may be used as a target for actual or threatened harm for controlling the other adult. Infants may become injured while being held in a parent's arm during an altercation. Children may be injured when they try to intervene to prevent a fight. Their needs may be neglected as the battered parent expends energy trying

not to incite their intimate partner. According to UNICEF, 63% of all boys who commit murder kill the man that was abusing their mother. The Boston Marathon Bombing is a recent tragedy allegedly caused by two brothers who immigrated to the US. It was revealed during the investigation that the brothers grew up with IPV.

Unfortunately in the US, there is an attitude of tolerance of parental violence towards children. It is not uncommon to hear caregivers state "Spare the rod, spoil the child," when justifying corporal punishment. This phrase is often misquoted and misinterpreted from Proverbs 13:24 in the Bible. In the King James Version, "He who spareth the rod hateth his son: but he that loveth him correcteth him be times." Most theologians would explain that this passage's true meaning is about discipline, a word whose root is "disciple," which means teacher. Parents need to teach their children right from wrong, so that they develop a strong moral character. What does it say about society when an adult who walks in a bar and slaps another patron across the face may be charged with assault, but a parent in a supermarket who slaps their child is exercising their parental right? There is considerable evidence-based medicine detailing the harms of corporal punishment.

Many states allow a parent to physically discipline a child by striking them with an object; other states specify that the object can only strike a child's thighs or buttocks as long as it doesn't leave bruising. And some states allow for bruising as long as it is not excessive. What does that mean and who makes that decision? Corporal punishment is not effective. It teaches children that those who are bigger than you are entitled to hurt you. It encourages children to lie in order to avoid physical pain. And most caregivers are not in control when they are physically disciplining a child. They are angry and frustrated. As a result, children are injured - sometimes so severely they die. In contrast, the American Academy of Pediatrics has a guideline about when inflicted skin injuries constitute abuse – basically any bruise however small.

Nineteen states allow corporal punishment in public schools. Some do not even require parental permission. A child is smacked on their clothed buttock with a paddle. Again, who decides what misbehaviors warrant paddling? And how many whacks? This practice is both demeaning and dangerous and also has not been shown to be effective. Sometimes litigation is necessary to change behavior. With several successful lawsuits brought on behalf of children who sustained injury from paddling, some school systems are discontinuing this practice. It is worth noting that 5 out of the top 7 states with the highest rates of maltreatment deaths allow corporal punishment in schools.

Although most childhood burns result from inadequate supervision, inflicted burns are a particularly heinous form of physical abuse. Whether immersing an infant or child in scalding water or applying a hot object to their skin, one has to assume that the intent of the caregiver was purely to inflict pain. Too often, a caregiver teaches a toddler not to touch a cigarette lighter, by heating it up and pressing it into their skin. Clearly, the caregiver's blame is misplaced. One common theme of physical abuse is the caregiver's lack of understanding of normal child development. Homes should be safety-proofed as toddlers are naturally curious and love to explore their environment through hand-mouthing behaviors. A caregiver should not leave dangerous objects within reach of a toddler. Burns are not only painful but they can leave permanent scarring, a reminder of abuse. Sometimes infants and children are "tortured" by their caregivers who use restraints to control behavior, withhold food and/or water, or subject children to repeated beatings or burns.

Direct-to-consumer drug advertisement has been legal in the US since 1985 but became more popular in 1997 when the Food and Drug Administration had less stringent requirements for listing side effects. Consumers are inundated with commercials that describe medication that can cure seemingly every ailment; the

purple pill for heartburn relief, the fluorescent butterfly for nighttime sleeping, the twin bathtubs for erectile dysfunction. We are a nation that no longer "says no to drugs". Consumer consumption of prescription medications has significantly increased. Prescription medications are the fastest growing drugs of abuse. The Drug Enforcement Agency has highlighted oxycodone, an addictive painkiller, as the "pill mill" epidemic. In addition, opioid use during pregnancy is estimated to affect 5.6 per 1000 births in the US.

Not all states provided data regarding maltreatment and caregiver risk factor for alcohol and drug abuse. However, of those that did, nearly 30% had an alcohol or drug abuse caregiver risk factor. Prescription drugs - opiates, benzodiazepines, antipsychotics and hypnotics, are now replacing caregiver use of typical street drugs - marijuana, cocaine, and methamphetamine. Regardless, drug use and abuse is bad. A mind-altering drug is just that. It alters brain function. Many opiate labels state under the warnings and precautions section, "may cause somnolence, dizziness, alterations in judgment and levels of consciousness, including coma." Any mind-altering substance can interfere with a caregiver's ability to parent and provide a safe and stimulating environment. According to the Center for Substance Abuse and Treatment, children whose parents abuse drugs or alcohol are 3 times more likely to be physically abused and 4 times more likely to be neglected. A substance-abusing parent often experiences irritability. Their behavior may be erratic. They may experience periods of irrational thinking, anger, or rage. Therefore, discipline may be inconsistent, unpredictable, or abusive. Due to their addiction and drug seeking, the primary focus of a parent is obtaining and using the drug. Shelter, food, proper hygiene, safety, nurture, and medical care are often not provided for their children. Additionally, an intoxicated parent may lose consciousness and if co-sleeping, may roll over onto and suffocate their infant or young child.

A recent study from Australia is illuminating. The authors prospectively followed a birth cohort of more than 3500 children who completed Australia's version of standardized tests at age 14. Notification to the state for abuse, neglect or both, whether substantiated or not, was significantly associated with lower reading ability and perceptual reasoning compared to non-referred children.

There are preventive measures that have been scientifically proven to reduce the risk of child maltreatment. As a student in the 1970s, Dr. Olds worked at a daycare center in inner city Baltimore. He reportedly felt that it was "too little and too late" to help those 3-5 year olds who had suffered significant trauma. He therefore began focusing "on helping a mother be a better parent from the time her child was born." First instituted in Elmira, New York, Olds established a visiting nurse educational in-home intervention for high-risk mothers. Many other regions throughout the country followed his initiative and instituted their own versions. Evidence-based medicine has shown statistically significant changes in parents' attitudes and behavior, and more importantly a significant reduction in abuse and neglect.

Safe Environment for Every Kid (SEEK) is another successful prevention initiative spearheaded by Dr. Howard Dubowitz. Using pediatric practices in low risk areas versus controls, the program trained health professionals to focus on specific child maltreatment risk factors during routine health maintenance visits. This model was associated with reduced maternal psychological aggression and minor assaults, clearly risk factors for abuse. Why aren't visiting nurse programs available in every city or SEEK incorporated into every pediatric practice? Home visiting nurse education programs are viewed as expensive, despite studies that show there is a significant net gain for every dollar spent. And physicians are just not comfortable with dealing with child maltreatment. According to Dr. Cindy Christian, one of the most important factors with physician's discomfort with identifying and reporting child maltreatment is lack of education. In fact, the median hours of child abuse

instruction reported by medical students during their four-year curriculum was two hours (range 0 to 10). This definitely does not seem proportionate to the most recent reported maltreatment rate of 9.1 victims per 1000 children in the population.

This nation has a very successful past history of approaching important health issues "head-on" and instituting change. Evidence-based medicine demonstrated that cigarette smoking caused lung cancer, cardiovascular and pulmonary disease. It was also shown that second-hand smoke was almost as dangerous, causing a myriad of upper respiratory and lower respiratory tract complications as well as lung cancer. There was a concerted societal effort to change attitudes and behaviors regarding cigarettes and with the support of legislation to ensure the physical well being of the non-smoker. Cigarette advertisements were removed from television, cigarette smoking was minimized in the media, and cigarette smoking was banned in airplanes, bars, restaurants and hospitals. In addition, laws prohibiting sales to minors were enforced and both state and federal taxes were placed on cigarettes, making purchasing a pack very costly. Many US elementary schools voluntarily created and implemented curriculum regarding the dangers of smoking. Similarly, the American Academy of Pediatrics developed a school-based curriculum whereby residents taught elementary school students the health consequences of smoking.

Why can't we do the same for child abuse? We have come a long way since the New York Society for the Prevention of Cruelty to Children was established in the late 19th century. There are now serious mandated child abuse laws, there are improved mandated child abuse curricula for daycare professionals and health care providers, there is increased training on recognizing child maltreatment for law enforcement and child protective services investigators, and since 2009, there is a new American Board of Pediatrics subspecialty, Child Abuse Pediatrics. We need to recognize that child abuse and neglect is the most important health problem affecting the future of our nation. It has been said, "It takes a village to raise a child." But in order to effect change, it must take a nation to protect a child.

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Reviews of the Fourth Edition

The 4th edition of Chadwick's Child Maltreatment *once again provides a comprehensive resource regarding child abuse and neglect. It is beautifully illustrated, well referenced, and very much up to date. Readers will be well served by this essential resource. In particular, the ophthalmology sections have been put together with expertise and offer excellent photographic examples of the findings in abusive head trauma. Ocular manifestations of abuse are well covered and the reader can expect a wealth of well referenced information that will directly impact their patient care.*

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The fourth edition of Chadwick's Child Maltreatment *ensures physicians, nurses, social-workers, and law enforcement professionals have a comprehensive reference that describes the identification, evaluation and management of all facets of child abuse and neglect. Of note, in an era when abusive head trauma (shaken baby syndrome) is often fiercely litigated in courtrooms and in lay media,* Chadwick's Child Maltreatment Fourth Edition *is a reputable source of mainstream, scientific information about abusive head trauma and its ophthalmologic manifestations.*

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This Chadwick's Child Maltreatment Fourth Edition *textbook offers a comprehensive and detailed accounting of the medical, social work, and legal assessment and investigation of the alleged childhood abuse victim. It serves as an excellent resource for the multidisciplinary team responsible for the evaluation of these complex cases. Dr. Debra Esernio-Jenssen has provided the clinician with a guide for how to accurately and effectively medically interpret bruises and the mechanisms of injury for these skin findings in children and adolescents. Dr. Randell Alexander carefully addresses the standards necessary for the multidisciplinary team to photodocument abusive injury. Anyone working in the field of child maltreatment should add this publication to their annals.*

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This work is excellent! At a time when child maltreatment science is growing exponentially, the release of the Chadwick's Child Maltreatment Fourth Edition *publication by Chadwick, Alexander, Giardino, Esernio-Jenssen, and Thackeray brings scholarship and practice expertise to those who deliver care to children who have been maltreated or abused. It should be in libraries worldwide.*

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The new Chadwick's Child Maltreatment *book is a must for health care providers who are seeing children who have been abused. There are many useful tips that professionals can adopt in their practice and use as a reference. The chapters are easy to follow as well as providing pictures with great case examples. The most current and up to date references in the chapters make it easy to follow the research in each area. I will be recommending this 4th edition as an excellent resource book for all programs that deal with child maltreatment.*

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The 4th edition of Chadwick's Child Maltreatment *is a comprehensive, evidence based text that is a critical reference for healthcare professionals who provide care for children and families. The array of expert contributors has crafted a publication that provides essential knowledge of the many facets of child maltreatment and includes contemporary references, images and case studies. I would recommend this edition of Child Maltreatment as a 'must have' resource for professionals committed to curbing the epidemic of child maltreatment.*

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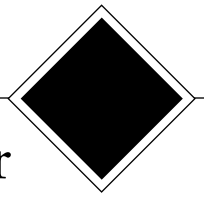
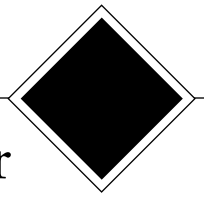


Contents in Brief



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CHILD MALTREATMENT

PHYSICAL ABUSE AND NEGLECT

Encyclopedic Volume 1 of 3
Fourth Edition

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Chapter 1

Overview of Child Maltreatment

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Since 1962, when Kempe and colleagues first described the "battered child syndrome,"[1] it has become increasingly clear that child maltreatment, including physical abuse, neglect, sexual abuse, and emotional abuse, is far too common, has profound short- and long-term effects on children and families, and is extremely costly to society. It also has become clear that much greater attention and financial support will be necessary to increase dramatically the efforts aimed at preventing child maltreatment and supporting families.

Before the article by Kempe and colleagues, observant radiologists raised important questions about how major injuries, such as fractures, occurred in young children and hesitantly proposed that these injuries were the result of actions by the caregivers.[2,3] Others, such as Adelson,[4] wrote about the killing of children.

Kempe's article, however, provided a major shift in the understanding of certain poorly explained childhood injuries that were seen by countless clinicians around the country. Whereas some clinicians had not recognized that parents and other caregivers were hurting their children, others likely had recognized the problem but had kept quiet about it because it was too painful and difficult to believe. Kempe and his coauthors provided information about both the clinical spectrum of the "battered child syndrome" and the first epidemiological study, in which 749 abused children were identified around the country. It seems very unlikely that anyone at that time could have foreseen what has been learned about the problem's extent over the last five decades.

The recognition of abused children created new problems and questions for hospitals and clinicians. What is the home like where the child was abused? Is it safe to send the child home, and, if not, where should the child go? In response to these types of questions and others and the need to protect children, state and federal legislation in the 1960s and 1970s established child protective services (CPS) agencies in each state, and laws were passed mandating that physicians and other professionals report suspected abuse to CPS.

Definitions and Epidemiology

Maltreatment of children includes neglect, physical abuse, sexual abuse, and emotional maltreatment. Neglect is defined as acts of omission and includes the failure to provide adequate nutrition, clothing, shelter, or supervision; abandonment; and failure to ensure that the child receives adequate healthcare, dental care, or education. Although neglect can be a single event, such as leaving a young child unsupervised in an unsafe setting, it often is a pattern of unsafe or inadequate care, such as a pattern of inadequate supervision or inadequate nutrition because of a serious mental health problem or substance abuse on the part of the caregiver. Clinicians must distinguish neglect from episodes of less serious failures to provide adequate care to a child, such as when a 10-month-old rolls off of a bed or a child has missed a few appointments for well-child care and has not received all of the recommended immunizations.[5]

Physical abuse is defined as acts of commission toward the child by a parent or caregiver. Such acts can result in harm to the child or they might intend to harm, although there may be no harm or only a minor injury. It can include injuries that occur when a child is physically punished severely or when a parent loses control and shakes a crying infant. Injuries that are suspicious for abuse or neglect must be distinguished from unintentional (or accidental) injuries. A specific form of child abuse, called medical child abuse, previously referred to as Munchausen Syndrome by Proxy, occurs when "a caregiver causes injury to a child that involves unnecessary and harmful or potentially harmful medical care."[6]

Sexual abuse is the involvement of adults, older children, or adolescents in sexual activities with children who cannot give appropriate consent and who may not understand the significance of what is happening to them.[7] Such activities violate family and societal taboos. Sexual abuse includes, for example, sexual touching of the genitalia, oral sex, attempted or actual sexual intercourse, including children in child pornography, or exposing children to child pornography. Although a 5-year age difference between "victim" and "perpetrator" is often used to decide whether sexual behaviors between two children should be considered sexual abuse, as opposed to "sexualized play," it is often more helpful to examine how invasive and persistent the behaviors are by the older child and whether the younger child wanted the behaviors to stop and felt threatened.

Emotional (or psychological) maltreatment is "a repeated pattern of damaging interactions between parent(s) and child that become typical of the relationship."[8] This form of maltreatment occurs when a child repeatedly feels that he or she is unwanted, unloved, or worthless. It includes denigration, belittling, and ridiculing; it can also include actively rejecting the child or ignoring the child's emotional needs. Although emotional maltreatment is likely the most common form of maltreatment, children are infrequently reported to CPS agencies for emotional maltreatment. Emotional maltreatment, however, often accompanies other types of abuse or neglect and plays a major role in the consequences of these types of maltreatment.

Much has been learned about the epidemiology of child maltreatment. Since 1976, each year in the United States, data have been collected from each state's CPS agency to track the number of reports and substantiated cases. Since 1990, these data have been collected by the National Child Abuse and Neglect Data System (NCANDS). By the early 1990s, there were over 3 million reports nationwide, and approximately one third of these reports were substantiated, meaning that the local CPS agency had enough evidence to believe that child maltreatment had occurred.

From 1990 to 2009, there was a substantial decline in the yearly number of cases nationwide of substantiated sexual abuse (61% decline) and physical abuse (55% decline) and a 10% decline in cases of substantiated neglect.[9,10] The decline in the occurrences of sexual and physical abuse is impressive and likely reflects real changes in how children are cared for in the United States. Some of the decrease in occurrence, however, may be due to other changes, such as the criteria used by CPS to substantiate reports of sexual abuse or how specific reports are categorized as abuse, neglect, or sexual abuse.[11]

In 2011, 3 million children were reported to CPS agencies nationwide, and 677000 cases were substantiated as being victims of maltreatment.[12] Thus 9.1 per 1000 children were subjects of a substantiated report of maltreatment. Of these, 78.5% were caused by neglect, 17.6% by physical abuse, 9.1% by sexual abuse, 9.0% by emotional maltreatment, 2.2% by medical neglect, and 10.3% by other types of maltreatment, including abandonment or congenital drug addiction. These percentages add to more than 100%, indicating that children can suffer from more than one type of maltreatment.

Chapter 2

Skeletal and Visceral Radiological Imaging

Megan Marine, MD
Richard Gunderman, MD, PhD

History of Child Abuse

Child maltreatment was first studied and described by French physician, Ambroise Tardieu in the mid-1800s before the use of diagnostic x-rays. Tardieu was a pre-eminent forensic medical scientist who devoted a significant part of his career to trying to unveil the inexplicable nature of child abuse. His work, *Etude Medico-Legale sur les Sevices et Mauvais Traitements Exerces sur des Enfants* (*Forensic Study on Cruelty and Ill-Treatment of Children*), published in 1860, is a classic description of battered child syndrome. He reported 32 cases, 18 of which resulted in death. A tireless advocate for children, he also published articles on the terrible working conditions children endured in factories and mines, as well as sexual abuse and infanticide. Many of his colleagues and successors did not believe his allegations of physical and sexual abuse. Unfortunately victims continued to suffer in silence for nearly another century.[1]

In 1946 John Caffey, pioneer of pediatric radiology, published the first systematic clinical and radiologic study of child abuse victims, reporting 6 children under age 2 years with extremity fractures and subdural hematomas.[2] Caffey's junior associate, pediatrician Frederick Silverman, then detailed the radiographic findings of child abuse in 1953, describing both posterior rib fractures and metaphyseal lesions, two of the most specific injuries highly associated with abuse.[3] Following Silverman's collaboration with pediatrician and researcher Henry Kempe, the landmark article "The Battered Child Syndrome," was published in the *Journal of the American Medical Association* in 1962, which led to the recognition of child abuse by the medical community.[4]

In 1972 Kempe founded The Kempe Center for the Prevention and Treatment of Child Abuse and Neglect. Twelve years later, Kempe was nominated for the Nobel Peace Prize for his contribution to child abuse prevention and treatment, and he is now considered one of the American pioneers of the detection, treatment, and prevention of child abuse. His efforts resulted in the adoption of abuse-reporting laws in all 50 US states.[5] Currently, all 50 states, the District of Columbia, and the US Territories have mandatory child abuse and neglect reporting laws that require that suspicions of abuse be reported to a child protective services (CPS) agency.[6]

Epidemiology of Child Abuse

The Child Abuse Prevention and Treatment Act (CAPTA), as amended by the Keeping Children and Families Safe Act of 2003, defines child abuse and neglect as any recent act or failure to act on the part of a parent or caregiver that results in death, serious physical or emotional harm, sexual abuse or exploitation; or an act or failure to act that presents an imminent risk of serious harm.[6]

The Child Maltreatment Report released in December 2010 found a staggering 702 000 US children to be victims of child abuse and neglect in 2009.[6] These numbers likely underestimate the extent of the problem, as reported cases understate

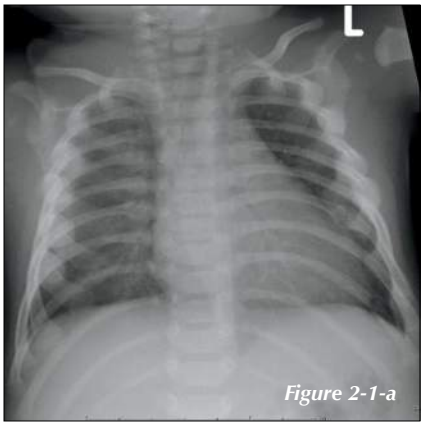

Figure 2-1-a


Figure 2-1-b

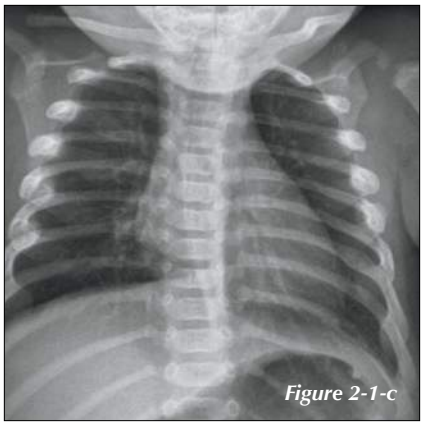
Figure 2-1-c

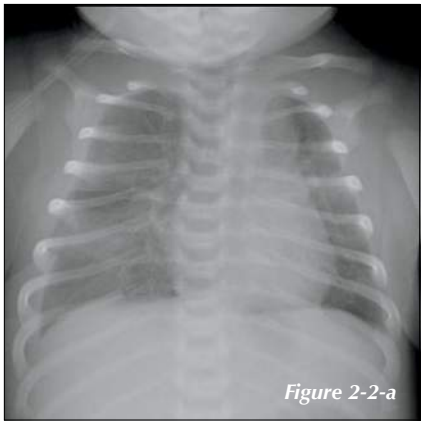
Figure 2-2-a

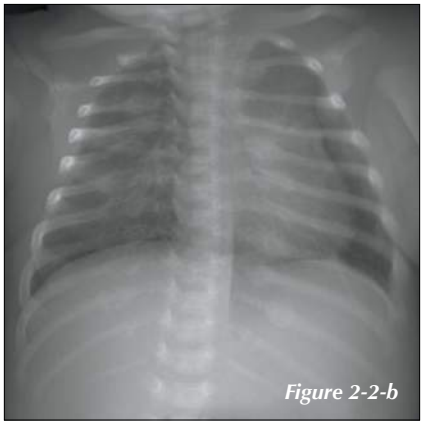
Figure 2-2-b

Figure 2-1-a. *Girl, 3 months old, with multiple bilateral posterior and lateral healing rib fractures with hard bony callus formation.*

Figure 2-1-b. *Same patient as in 2-1a, 2 days later. Technetium 99m MDP bone scan demonstrates multiple bilateral rib fractures.*

Figure 2-1-c. *Nineteen days later. Note the change in the appearance of the healing rib fractures. The proximal left humeral metaphyseal fracture now also noted.*

Figures 2-2-a *and* ***b.*** *Boy, 22 days old, with bilateral acute posterior rib fractures. On the right, 14 days later, the fractures now show bony callus formation.*

moderate specificity include multiple fractures, fractures of different ages, epiphyseal separations, vertebral body fractures, digital fractures, and complex skull fractures. Low-specificity fractures for abuse include subperiosteal new bone formation, fractures of the clavicle and long bone shaft, and simple skull fractures.[23]

Posterior and lateral rib fractures are considered to be caused by squeezing or compressive forces.[24] These fractures are not uncommonly multiple. When faced with multiple fractures, it is important to determine the ages of the fractures, as finding fractures of differing ages increases concern for child abuse. The timetable of radiographic changes include soft tissue swelling, followed by subperiosteal new bone formation as early as 4 days and always by 2 weeks, loss of fracture line and soft callus, hard bony callus, and bony remodeling peaking at 8 weeks. There is, however, considerable overlap, making the dating of fractures an inexact science relying on the radiologist's personal clinical experience.[25] (**Figures 2-1-a** and **b**).

Repeat radiographs or skeletal survey performed approximately 2 weeks after the initial examination can provide additional information on the presence and age of child abuse fractures.[26] These should be performed when abnormal or equivocal findings are found on the initial study and when abuse is suspected on clinical grounds.[27] (**Figures 2-1-c, 2-2-a** and **b**).

A classic metaphyseal lesion occurs when an acceleration-deceleration and/or torsional force is applied to the immature primary spongiosa adjacent to a cartilaginous growth plate, the most immature portion of metaphysis.[28] These fractures are commonly referred to as "corner" or "bucket-handle" type fractures depending on the projection of the radiograph. (**Figures 2-3-a** to **d, 2-4** and **2-5-a** to **c**).

Sternal fractures have a higher specificity for child abuse but are uncommon, given the malleability of thorax at an early age. Mechanism of fracture is likely direct blow or forceful compression of chest.[29,30]

Scapular fractures are also rare, thanks to their protective surrounding muscle and connective tissue. The mechanism is typically severe, high-energetic trauma. The acromion is the most common location for a fracture, which can result from indirect trauma such as shaking or when arm is turned onto back with significant force.[30] (**Figures 2-6-a** and **b**).

The rapid growth of the spine during adolescence influences its anatomy and biomechanical properties, particularly in the lumbar area. Spinous process fractures, while more specific for child abuse, are less common than vertebral body fractures, which are only moderately specific. In a child with a thin abdominal wall, the fulcrum of a flexion injury would be at the body of the spine, which exposes it to a flexion-distraction injury (Chance fracture).[31] Compression fractures also result

Figures 2-3-a *and* ***b.*** *Girl, 5 months old, with slight irregularity of the proximal tibia metaphysis.*

Figures 2-3-c *and* ***d.*** *Follow-up radiographs 16 days later better demonstrate the healing proximal tibia classic metaphyseal lesion or "bucket handle" fracture.*

Figure 2-4. *Girl, 3 months old, with healing distal tibia and fibula metaphyseal fractures.*

Figures 2-5-a *and* ***b.*** *Boy, 20 months old, with acute distal radius CML. Normal left side is shown for comparison.*

Figure 2-5-c. *Same patient as in 2-5-b, with less commonly seen healing metacarpal fractures, moderately specific for child abuse.*

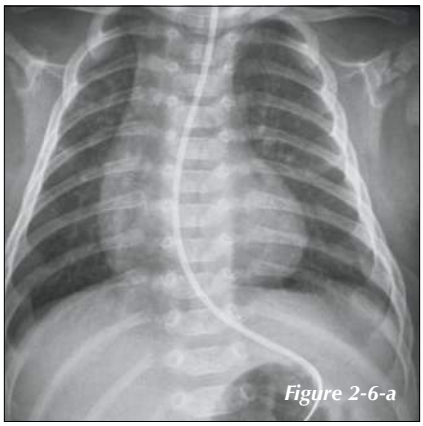

Figure 2-6-a. *Child, 2 months old, with left acromion fracture.*

Figure 2-6-b. *Three days later, bone scan demonstrates left acromion fracture and better shows left lateral rib fractures.*

Chapter 4

Burns in Child Maltreatment

Aaron Miller, MD, MPA

Burns are the third leading cause of death associated with child maltreatment[1] and pose many of the same diagnostic challenges of the two leading causes of death - head trauma and abdominal trauma. Medical professionals are asked not only about the mechanism of a burn, but also whether the manner was necessarily abuse, neglect, or an accident. With only a few burn patterns that are distinctive for abuse versus neglect and accidents, it is vital that the clinician be able to elicit the truth or identify important inconsistencies from the caregiver and patient. Clinicians must also be able to work closely with child protective services and law enforcement to further clarify findings.

Discerning Physical Abuse from Neglect and Accidents

When a child's caregiver provides a history that is not consistent with the child's injuries, significant concern arises that the child was abused or neglected[2]; however, very little research or training exists for medical professionals to learn how to ask questions of a caregiver in a way that increases the likelihood of eliciting the truth or important inconsistencies.[3,4] Listed in this section are a few steps for interviewing caregivers and then for performing the medical exam. The remainder of the chapter will discuss the various types of burns, factors that help determine the manner of the burn, and questions that must be asked of child protective services and law enforcement to assess and confirm whether a caregiver's statements are consistent with the child's injuries. Interviewing children without their caregiver present is also vitally important,[5] but this topic is discussed in great detail in Volume 2 of this text.

Interviewing Caregivers

Abusive caregivers sometimes delay in seeking medical care for their child; however, often the abuser brings the child to the hospital or a private medical office in a timely fashion and is accompanied by a partner who does not know the child was intentionally abused. The most important first step is to interview the caregivers separately. When caregivers are interviewed together, the nonabusive caregiver may answer a question that the abuser struggled with and thus raised the clinician's suspicion. The abusive caregiver may feel more guarded in the presence of a partner and less likely to admit the stress he or she is experiencing or to disclose specific actions or mistakes that contributed to or caused the injury. The nonabusive caregiver is also less likely to disclose any type of violence that may be going on in the home.

Medical providers should ask questions in open-ended fashion to elicit greater accuracy of information and greater amounts of information.[6] When discussing the present injury, a typical transition could be: "Tell me everything that happened from the beginning – where were you? Where was everyone else? What was going on right before this happened?" It is important not to interrupt the caregiver, even when he or she pauses or makes statements that are confusing. This may cut off important statements that lend greater weight to whether the history is credible or not. After the caregiver completes the narrative, further questions can be asked for clarification.

Careful attention should be paid to the child's previous state of health, including development, behavior, and the details of the incident resulting in the burn, including time, source of heat, supervision of the child, and location of others at the time of the incident.[7] Certain factors in the history should alert the examiner to the possibility of inflicted injury, including the child's age, tap water as the source of heat, and histories requiring developmental skills beyond the child's age.[8,9] Abusive scalding tap water immersion burns may occur after a toddler soils himself. The frustrated caregiver goes to clean the child in the bathtub and then forces him or her into scalding hot water.[10] Asking what happened right before the burn can help elicit a history of what may have triggered the caregiver's abuse.

If a caregiver gives an answer that does not seem plausible, the medical professional should inquire further. The caregiver might not be covering up abuse, but rather covering up a mistake or poor judgment that may have led to the child's injury. This mistake or poor judgment may be considered neglect or an accident, depending on the circumstances. The difference between these two – neglect versus accident - can lead to very different assessments by the multidisciplinary team concerning the child's safety in the custody of the caregivers.

When the child was not brought immediately to the medical provider for treatment, several possibilities should be explored, for example, the caregiver may not have had the means or money to get to the hospital or may not have a phone to call for help. Additionally, a burn may appear as a simple, superficial burn and not develop a blister until later, which may not be noticed until after a nap.

Figure 4-1. *Sunburn causing large areas of superficial burn and smaller areas of partial-thickness burn with blisters.*

When there is concern that a burn may have been inflicted, medical professionals should feel comfortable in the role of helping children and families by asking caregivers whether they hurt their child. To be clear, medical providers are not investigators and do not need to confront caregivers with all the inconsistencies in their stories. (These issues are discussed further in Volume 3, Chapter 9 "The Role of Law Enforcement in the Investigation of Child Maltreatment.") It is appropriate for medical professionals to ask sensitive questions in a supportive manner. One way to do this is to first acknowledge to the caregiver how difficult it is to care for children and then note that they can see the caregiver cares for the child. After waiting for a response and responding back, these comments can be followed by "Is it possible that with all this stress you just lost control for a few seconds and your child got hurt?"

Examining the Child

After interviewing each caregiver and the patient, a careful physical exam is needed – from the scalp and oropharynx down to the toes – to assess for additional injuries that may yield more information about the extent and cause of the child's injuries.[11]

Burns are described by the depth of the burn, the source of the heat, and the shape of the burn on the body. Superficial burns (sometimes called first-degree burns) (**Figure 4-1**) involve only the epidermal layer. Partial-thickness burns (sometimes called second-degree burns) (**Figure 4-2**) involve the dermis, causing a blister, and are further characterized as superficial partial-thickness or deep partial-thickness, the latter of which may sometimes need skin grafting. Full-thickness burns (sometimes called third-degree burns) (**Figure 4-3**) often need skin grafting, extending completely through the dermis and causing damage to hair follicles, sweat glands, and nerves. These burns can appear white and may not be painful due to nerve death. Full-thickness burns that damage tendons and muscle tissue are sometimes referred to as fourth-degree burns. Whether a burn is partial-thickness versus full-thickness can be difficult to ascertain during the initial physical exam and sometimes is not fully evident until 1 or 2 days later.

Sources of heat include thermal (scalds, flames, contact with hot object), chemical, electrical, radiation, and friction/pressure. The shape of a burn and its distribution on

the body are very important in determining the source of the heat and the manner of the burn. Scald burns, the most common type of burn in children under age 5 years, are described as a flow pattern, a splash, or an immersion burn.[12,13]

The percentage of body surface area covered by the burn is best estimated by age-corrected surface area charts such as Lund-Brower or Berkow charts. Because of the progressive nature of thermal injury, the true depth of the burn may not be fully apparent for 24 to 48 hours. If the child's injuries allow it, direct observations of the child's developmental capabilities should be made to assist in determining the credibility of the history given.

A skeletal survey should be performed in all cases of suspected abuse, as children with concerning burns have higher rates of occult fractures.[14,15]

The medical treatment of burns is outside of the scope of this chapter; however, it is important to note the short- and long-term consequences of burns in order to educate families, social services, and courts as to the challenges and needs that the child may encounter. Short-term consequences can include the need to be hospitalized, causing parents to miss significant work and risk losing their jobs; significant pain at rest and during debriding sessions; fever; infection; feeling miserable and needing a feeding tube for nutrition; needing surgery with its accompanying risks; and post-traumatic stress disorder. Long-term consequences can include death, physical impairment, contractures, and disfiguring scarring that can significantly affect mental health and self-esteem.

Types of Burns

Scald Burns

Scald burns have long been a plague to children's health. Felix Wurtz, a surgeon in Switzerland, described this danger in 1563 in one of the first books on Pediatrics published in western Europe: "Touching Baths of Children, it is known that they are bathed sometimes so hot, that the heat thereof is scarcely sufferable to an old bodies hand, whose skin is strong… The bodies of such little Children may be compared to a young and tender root or twigg of a Tree, which in the souch is not so grosse as an old root or branch of a Tree; take heed you cause no paines unto little Children."[16]

Most scald burns are accidents that occur in the kitchen, where even a moment's inattention allows a child's curiosity and quickness to result in pulling a hot beverage or pot off a table.[11] Spilling liquids cause burns described as a "splash" or "flow" pattern. Flow burns sometimes are further described as having an "arrowhead" shape, with the widest and deepest part of the burn at the top, or point of first contact.[17] The pattern both narrows and becomes less deep because the liquid cools as it flows down the body (**Figure 4-4**).

Thick liquids such as grease, oils, or syrups maintain their heat for longer periods and can be at a higher temperature than the boiling point of water. Thus they may produce a more extensive burn pattern. Microwaves heat food and liquids unevenly;

Figure 4-2. *Partial-thickness immersion burns.*

Figure 4-3. *Flame burn resulting in charred areas of full-thickness burns.*

Figure 4-4. *Note the indistinct edges and multiple inverted "arrow" shapes in this splash burn from grease.*

thus a parent or child may think that the food is a safe temperature only to get burned seconds later with a portion of the food that is much hotter.[18]

Anything that excludes water from the skin surface, like diapers, will spare that area. Children may flex their limbs, causing folds of skin that are spared.[11,19] Wearing a shirt often creates an irregular pattern on the trunk. The hot water may cause more severe burns where a thin shirt is lying flat on the body, but a less severe burn if part of the shirt was slightly folded over (like a collar), allowing less contact with the skin. However, hot water that flows under or soaks clothing may cause a more severe burn in that insulated area.

Immersion Burns

With immersion burns, the exact number of seconds or minutes needed to cause partial or full-thickness burns in children at a given water temperature is not known. Good estimates have been extrapolated from a study in 1946 in which 7-mm scald burns were inflicted on adults' skin (**Table 4-1**). It can be expected that children's skin will burn in less time.[20]

Table 4-1. Time to Partial-Thickness Burn by Water Temperature in Adults

Degrees Centigrade	Degrees Fahrenheit	Time (Seconds)
65	149	1
60	140	2
55	131	12
50	122	120
45	113	10 800

The term ***immersion burn*** simply means that the child sustained her burn in a pool of hot liquid. It does not imply whether the manner was abuse, neglect, or an accident. Scald burns with sharp margins suggest the possibility of abuse by immersion in a hot liquid (**Figure 4-5**).[21] This pattern of burn results from the caregiver holding the child in the water, whereas an accidental immersion often results in splash patterns as the child struggles to escape the water. The typical pattern of inflicted scald burn is an immersion burn with sharply demarcated borders and a uniform intensity of burn. On the extremities a stocking/glove pattern (**Figure 4-6**) (with or without buttock involvement) should cause suspicion. It is unlikely that a child will hold the extremities in hot water without splashing the water in an attempt to escape.

If the child is immediately pushed and held with the buttocks touching the tub surface, the area of buttocks that is pressing against the tub may be spared, causing a "doughnut"-shaped buttock burn with central sparing (**Figure 4-7**). Inflicted craniofacial tap water immersion burns are less common but have higher mortality.[22]

With scald burns occurring in the bathroom, a common history provided by caregivers is that they stepped out of the bathroom for "just a few seconds" to get a towel or answer the phone and then returned to see the child was burned. Rather than asking "What did you do next?", the next question should be "When you came into the room, what did you see?" This is an open-ended question that can be tough to answer for an abuser if this is not what happened. The abuser may give details about the child's comportment that are inconsistent with the medical findings.

If the caregiver states that the child must have climbed into the tub on his own, it should be kept in mind that one third of toddlers age 10 to 18 months can climb

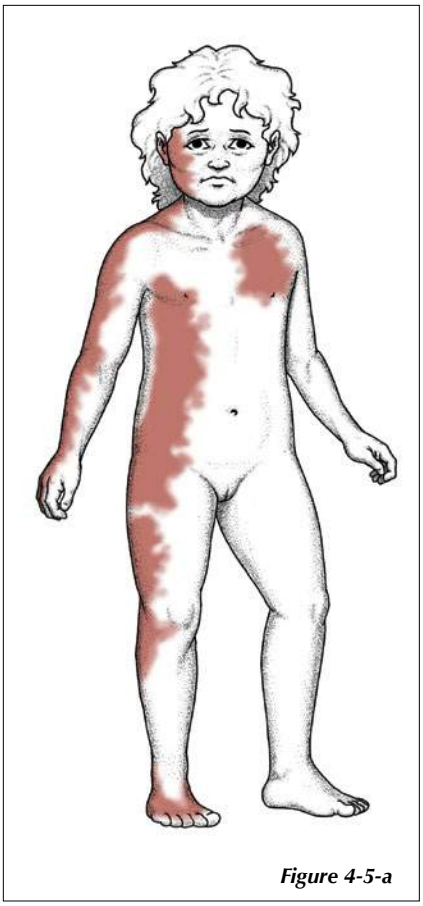

Figure 4-5-a

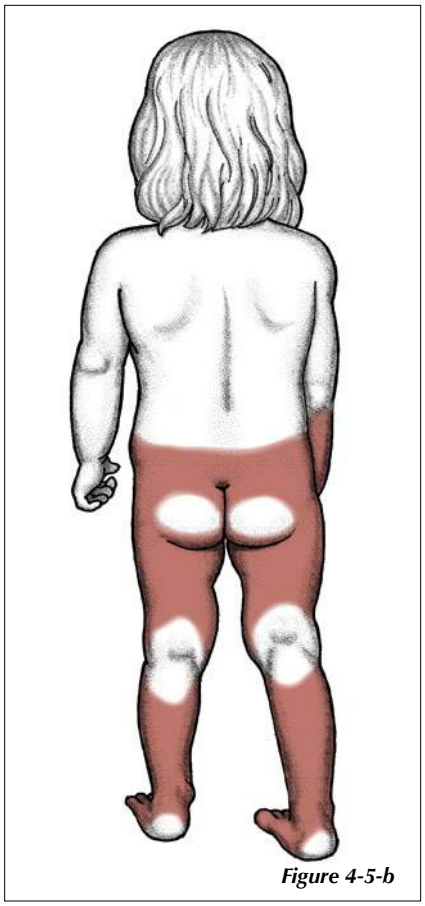

Figure 4-5-b

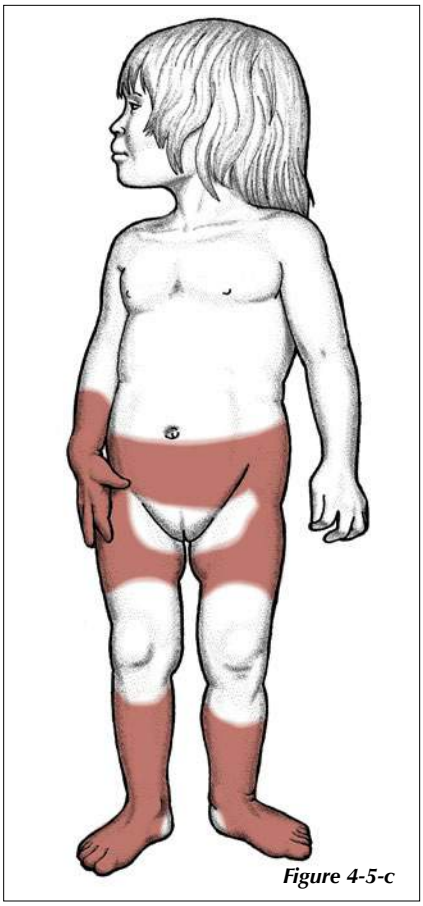

Figure 4-5-c

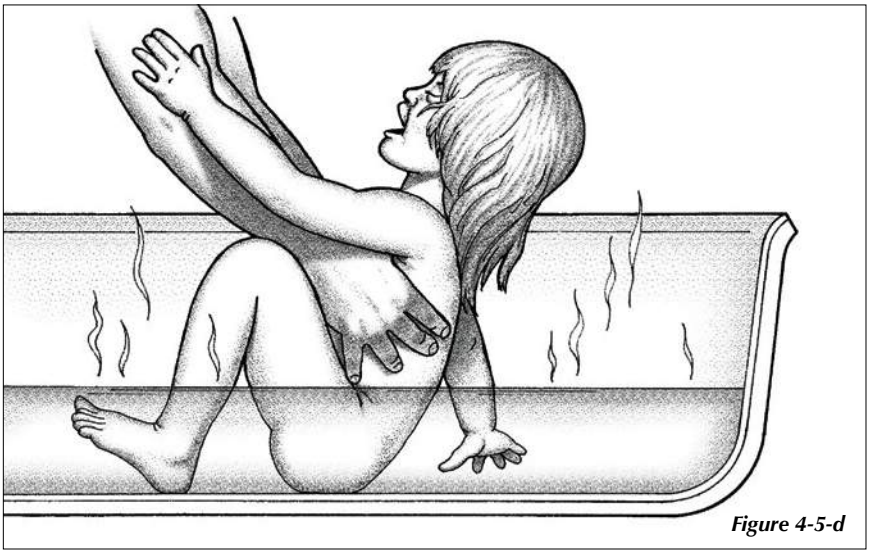

Figure 4-5-d

Figure 4-6-a

Figure 4-6-b

Figure 4-5-a. *Splash burn pattern.*

Figures 4-5-b, c, *and* ***d.*** *Immersion burn patterns.*

Figure 4-6-a. *Stocking pattern typical of immersion burns.*

Figure 4-6-b. *Glove pattern in immersion burn.*


Figure 4-7


Figure 4-8


Figure 4-9

Figure 4-7. *Full immersion burn pattern. Note the spared folds and clearing.*

Figure 4-8. *Curling iron burn. Note the diffuse edges where the iron bounced/rolled down the arm.*

Figure 4-9. *Forced contact with heater grate indicated by bilateral involvement and sharp "branded" borders.*

into a standard bathtub 35.6 cm (14 inches) off the ground.[23] However, in these cases the child should have irregularly shaped splash and flow burns of different degrees, spread over a wide distribution of the arms, legs, and trunk as the child struggled to get up.[11,24]

Coordination with Child Protective Services and Law Enforcement

Medical providers should discuss with child protective services and law enforcement specific information that would help the medical team determine whether the injury was consistent with the history provided by the caregivers.[19] With scald burn injury, investigators should take a thermometer, tape measure, stop watch, and camera to the scene of the injury. A scientific thermometer provides the needed accuracy and precision to measure water temperature; these thermometers can be purchased on the internet. Meat thermometers are not sufficiently accurate.[19] The water temperature should be checked at the spigot while a watch keeps track of the time needed to reach 54° C (130° F), 60° C (140° F), etc. Attention should be paid to how much water pools in the tub or sink when the stopper is open.

Multiple photos should be taken of the room where the injury occurred. Measurements should be taken of the width, height, length, inside depth, and distance from the basin to the spigot.[19] Investigators should then check the water heater. If the home uses an electric water heater, both the upper and the lower thermostats, which operate individually, must be checked. To avoid electrocution, investigators should disconnect the power source for the electric heater before inspection.[20]

If the water heater temperature is higher than allowed by law, the landlord is libel for criminal neglect. Landlords often learn of an investigation very quickly, and they can easily change the water temperature down to the legal limit. It is therefore important to check the water temperature on the first day of the investigation.

Neglect at Multiple Levels

If a child is left alone in a bathtub and gets burned by tap water that is 60° C (140° F), this represents neglect on at least three levels – the home (caregiver), the community (landlord), and society, where political leaders ignore scientific data and calls to action to create simple laws - implemented and monitored at little cost – that have been shown to significantly decrease the number of tap water scald burns suffered by children.[25] Like any other disease where prevention is key and can help avoid pain, suffering, and death – medical providers can help prevent these injuries by educating and advocating for children at all levels, from family members to lawmakers.

Contact Burns

Contact with hot objects is the second most common cause of burns in small children.[13] In general, accidental contact burns are more likely to have indistinct margins caused by the object falling onto the child or the child's efforts to escape, while abusive contact burns are more likely to have distinct margins, grouped burn lesions, clearly inscribed patterns, and injuries on parts of the body normally covered by clothing.[5,26] Most unintentional contact burns to the hand could be expected to occur on the palmar surface as the child attempted to touch or grab the object with those exploratory surfaces.

Irons, curling irons (**Figure 4-8**), cigarettes, and furnace grates (**Figure 4-9**) are just a few of the items that cause burns from abuse, neglect, and accidents. If a hot iron is left somewhere so that a toddler can grab the dangling cord, the edges of the falling iron can cause a burn with a smeared edge.[24] If the burn is the shape of the flat surface of the iron and/or shows the steam holes, physical abuse is highly suspected.

Chapter 5

Bruises in Child Maltreatment

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Bruises and other skin injuries are common findings in child abuse. Skin injuries are often the sentinel injury, leading to a workup that reveals other injuries, but they may be the only finding in abuse. When other, more medically serious injuries are present, the presence and character of bruises clarify whether the injuries result from abuse or accidental means.

Bruises may "look like abuse" to medical providers and lay people alike. However, a careful analytic approach to skin findings is needed to achieve the most accurate understanding of these findings. It is critical to understand other diseases, including hematologic condition that can produce easy bruising. In addition, the clinician must be able to identify the many "lookalikes"—non-traumatic causes of bruise-type marks.

What is a bruise?

A ***bruise*** is extravasation of red blood cells across the vessel membrane into the skin, subcutaneous soft tissue, or both. Typically it is caused by blunt injury to the skin that does not break the skin surface, causing discoloration. ***Contusion*** has the same meaning as bruise, but can also apply to internal organs such as the brain or liver. ***Hematoma*** is the term commonly used to describe a large localized mass of extravasated blood. Hematomas can occur in internal tissues or on the scalp, where the injury resembles a golf ball. Hematomas may become clotted and organized. ***Petechiae*** (singular, ***petechial***) are pinpoint bruises in the skin. Petechiae may be caused by blunt force, by increased venous pressure (for example, resulting from a tourniquet or strangulation), or when disease causes vessel leakage.

With blunt-force trauma to the skin, the first visible reaction is a welt, or ***erythema.*** Redness and localized swelling are caused by a local reaction to stimulation, but resolve within minutes to hours. A bruise may become visible on the surface of the skin hours or even days after injury. Because petechiae are so superficial, they may become visible within minutes.

Dating Bruises

Bruises change through a predictable color progression: red-purple to blue to green-yellow and then to brown. Color changes in the bruise result from hemoglobin breakdown into various pigments: free hemoglobin (red), deoxygenated hemoglobin (dark red/black), biliverdin and bilirubin (green to yellow) and lastly, hemosiderin (yellow to brown). Although the order is predictable, the timing is not. Colors typical of "early bruises"—red, blue, and purple—can also be found in bruises older than 7 days. Yellow, green, and brown, colors common in bruises older than 7 days, can also be found in bruises less than 48 hours old.[1] Bruise color changes differ among individuals, with age, and even in the same person. Bruise color evolves differently depending on the nature of the underlying tissue and the depth of the bruise. There is poor inter-observer agreement in describing bruise coloration even when bruises are

Figure 5-8. *Four-year-old girl with bilateral bruises at the gluteal cleft, caused by abusive spanking.*

Figure 5-9. *Crimp-type bruises to the upper pinna in a 4-year-old, caused by a forceful slap or strike to the side of the head. The edge of the ear is pinched between the inflicting hand and the skull. (Photo courtesy of R Wiester, Seattle Children's Hospital.)*

Figure 5-10. *Two year old boy with bruising of the antihelix of the auricle. This injury rarely occurs in normal activity, and is usually caused by a blow to the head.*

Figure 5-11. *Fifteen-month-old girl with a crimp-type bruise on the pinna and bruise on the face caused by extension of a scalp hematoma. These injuries were probably the result of two separate blows to the head.*

Figure 5-12. *Toddler with critical brain injury with a bruise to his upper medial arm, very likely to have been caused by an adult's grip.*

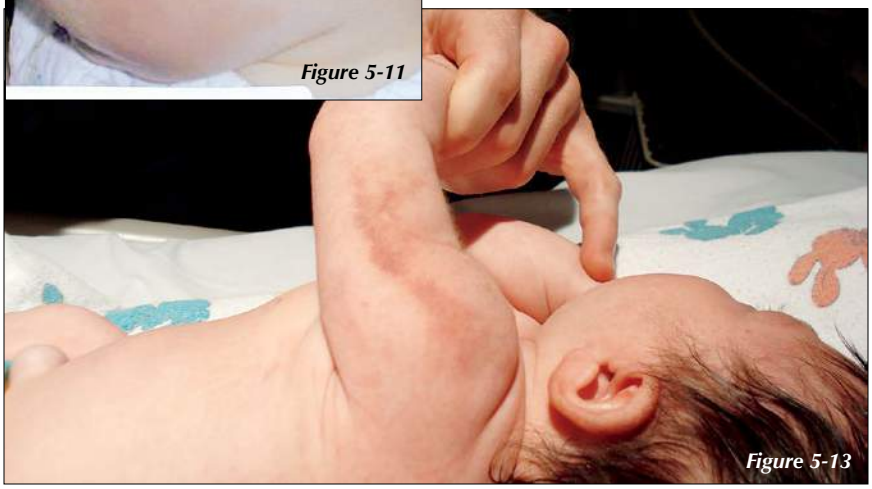

Figure 5-13. *Six-week-old with torn frenulum, several rib fractures, and this crimp-type injury to his upper arm, likely caused by a forceful grip.*

Figure 5-14. *Crescent shaped marks are typical bite marks. Careful measurements should always be taken, along with swabs for DNA identification.*

Young infants have been found to have bruises on the palm or dorsum of the hands. This is certainly not caused by the infant's own actions, but by another person's forceful compression of the infant's open hand or closed fist. Grip mark injuries may be visible on the leg or upper arm, typically as two or three small circular bruises on one side of the limb. Sometimes, but not uniformly, there is a single bruise that conforms to a thumbprint on the other side (**Figure 5-12**). In infants, bruises that are a single vertical line on one side of the limb may be caused by a grip of the limb that causes crimping and pinching of the skin (**Figure 5-13**).

Bite mark bruises appear as single or facing half circles or crescents (**Figure 5-14**). When the tooth marks are visible it is helpful to measure the space between the lateral incisors. Lateral incisor separation of less than 2.5 cm is likely to indicate that the bite is from another child. However, when there is serious concern of biting by an adult, it is more valuable to swab the area for saliva DNA, which can be used to more conclusively identify the biter. High-quality photos that include a measurement scale will allow a forensic odontologist to review in consultation later if needed.

Petechiae

Petechiae are pinpoint bruises and may be a sign of a low platelet count. Petechiae also occur with normal platelet counts in areas of direct pressure or as a consequence of increased capillary pressure from occlusion of venous return. Examples of the latter are petechiae "above the nipple line" that occur with severe vomiting, gagging, coughing, or other valsalva maneuvers. Strangulation and severe chest compression both impair venous return through superior veins and can cause petechiae of the face, conjunctiva, and upper chest. Viral illnesses or bacterial sepsis may cause relative capillary fragility, and petechiae may occur with less force than in the usual setting (**Figure 5-15**).

Differential Diagnosis of Bruises

Normal Variants and Mimics

Normal variant pigment changes may be mistaken for abusive bruises. ***Mongolian spots*** (steel blue nevi) are a common birthmark in neonates and children (**Figures 5-16** and **5-17**). These pigmented patches are present in at least 9.6% of white, 95.5% of black, 81% of Asian, and 70% of Hispanic babies.[20] Mongolian spots are common over the sacrum, but can be present on most areas of the body, including the limbs, hands and feet. When there is inflammation or skin disruption, children with medium or darker pigmented skin often heal with hypopigmentation or hyperpigmentation, so scars or pigmentary changes are visible much longer than on the skin of paler children. Occasionally vascular nevi may be mistaken for bruises; the key differentiating feature is whether these marks change over a few days.

Striae (stretch marks) are normal variant skin marks that appear in adolescents at body areas of rapid growth. On girls, this is typically on the breasts and hips. In adolescent boys, striae may be present on the back as multiple parallel horizontal marks and can be mistaken for whip marks. These marks may be pink or pale, and they are usually slightly depressed.

Phytophotodermatitis is a cutaneous reaction produced by contact with a number of plant substances followed by sunlight exposure. The reaction may be inflammatory with erythema and blisters, but often is manifested by irregular hyperpigmented areas that can be mistaken for bruises. Many plants, including limes, lemons, parsley, and celery, contain psoralens (furocoumarins), the sensitizing agent. A history of plant and sunlight exposure, combined with irregular hyperpigmented marks that are not actually bruises, should suggest this diagnosis.[21]

Ligature marks at the wrists, ankles, or more proximal limbs occur when an object encircles and damages the body part. Ligatures may be caused by abusive action, such as tying a child with a string, rope, or belt. However, it is not unusual to observe

Figure 5-15. *Petechiae on the face. This 3-year-old girl said her father choked her. She did not lose consciousness. It is likely that she had a concurrent viral illness that predisposed her to developing petechiae.*

Figure 5-16. *Mongolian spot (slate blue nevus) on the upper back in a 2-month-old.*

Figure 5-17. *Mongolian spot (slate blue nevus) in an Asian infant. (Photo courtesy of R Wiester MD, Seattle Children's Hospital.)*

Chapter 13

Burns Atlas

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Children who are burned abusively are marked or branded with the outward manifestation of parental violence, emotional imbalance, impulsivity, educational and cultural deprivation, and poverty. Intentionally burning a child is controlled and premeditated.

Abusive burns cause both physical and emotional trauma at the time of the incident, and often produce long-term physical and psychological scarring. Individuals who burn children typically are educationally deprived, abuse women (if male), and may be isolated, suspicious, rigid, dependent, or immature. They often display more concern for themselves than the child, frequently show little remorse, and are evasive and contradictory. They generally do not volunteer information, seldom visit the child in the hospital, and rarely ask questions about the child's condition. By contrast, parents whose child is unintentionally burned usually blame themselves for a lack of supervision and may display a profound sense of guilt.

Burn injuries can be divided into 6 categories: flame, scald, contact, electrical, chemical, and radiation (eg, sunburn from ultraviolet radiation). Abusive burns generally cluster in the scald and contact categories, although there are reports of other types of burns. Children's skin is much thinner than adult skin, so serious burning occurs more rapidly and at lower temperatures. Electrical burns can be deceptive since trauma may not always be outwardly apparent. Electricity follows the path of least resistance, and skin is a natural resistor to electrical flow. Nerves, muscles, and blood vessels, however, are good conductors and therefore, are more susceptible to electrical trauma. Electrical flash burns are caused when the current is shorted, producing a very brief, high intensity fireball that causes thermal injury. Flash burns char the superficial layers of skin, but usually do not cause destruction of deep tissues.

The first priority for the burned victim is to medically treat the injury. Once accomplished, efforts can then be directed toward obtaining an accurate history from witnesses and family members. Specifically, the timing, nature, extent, and location where the burn occurred. Medical personnel must document the exact shape, depth, and margins of all wounds, and include all affected body parts. Immediate attention to these details may prove invaluable when ascertaining whether the burn resulted from an abusive or unintentional injury.

Medical providers may choose to interview the child victim. It is important that the child's safety is assured and that they will not be longer be harmed. General open-ended questions are preferred, such as: How did you get hurt? More detailed, specific questions may be asked after the child victim has had the opportunity to tell their story. It is also important to ascertain whether the child has been coached or threatened, if they tell.

Other important factors to consider when examining a burn victim, is the length of time it takes for a second- or third-degree burn to occur relative to the temperature of a given liquid (**Figure 13-1**), the surface temperature, and the location of the

Contact Burns

Fireworks

Case Study 13-59

This child was brought to the ER for severe burns to his upper thigh and genital area. He was carrying firecrackers in his pocket which ignited when they came into contact with sparks from other fireworks, causing the firecrackers to explode. This unfortunate incident resulted from inadequate adult supervision.

Figure 13-59. *Burn to the thigh from fireworks.*

Case Study 13-60

This infant presented with facial burns. According to the caregiver, the child was crawling in a backyard where fireworks were being thrown .A bottle rocket exploded under her chin, hitting her in the face.

Figure 13-60. *Fireworks burn.*

Case Study 13-61

The caregivers of this 4-year-old boy reported that he was unintentionally burned when he ran into someone who was running with a sparkler.

Figure 13-61. *Periorbital burns.*

Contact Burns

Space Heater/Radiator

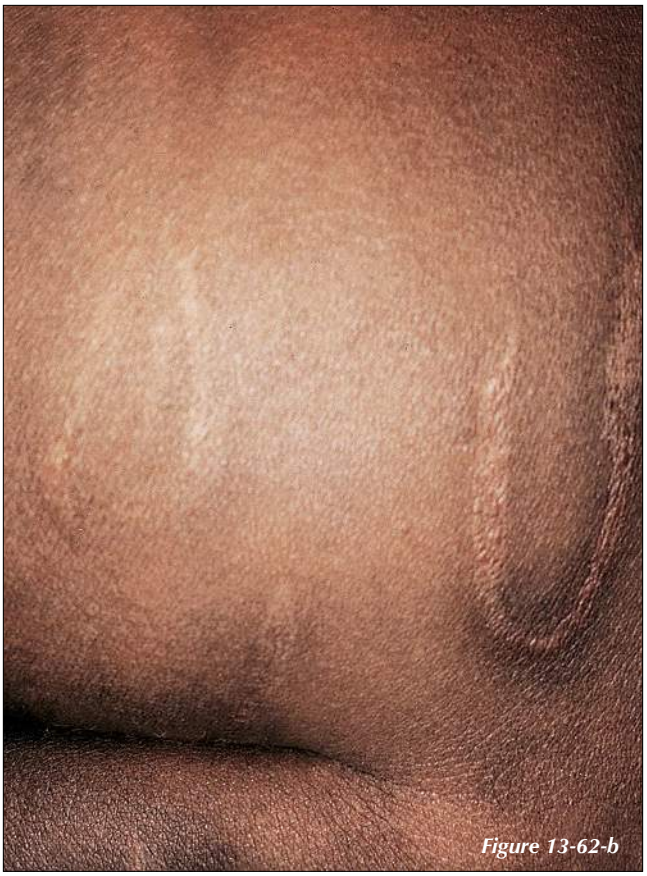
Case Study 13-62

This 4-year-old child was taken to the ER by his parents for a burn to the dorsum of his right foot. The parents reported that the child had accidentally placed his foot on the top of a space heater. However, the injury appeared older than the alleged day of the incident, the burn was on the top of his foot, there were healed loop marks on his back, and a well-healed burn scar to his chest.

Figure 13-62-a. *Burn to the dorsum of right foot.*

Figure 13-62-b. *Healed loop marks on his back.*

Figure 13-62-c. *Well-healed burn scar on his chest.*



Mimics

Erysipelas

Case Study 13-102

This 5-month-female with symptoms of an upper respiratory tract infection developed this redness on her bottom within a 4 hour time span between diaper changes. Cultures and skin biopsy revealed that the redness was due to erysipelas, most likely group *A streptococcus*. The rash resolved with antibiotic treatment.

Figures 13-102-a, b, c, *and* ***d.*** *Erysipelas on the child's buttocks and anus.*

Figure 13-102-a

Figure 13-102-b

Figure 13-102-c

Figure 13-102-d

Mimics

Diarrhea

Case Study 13-103

This 18-month-old had a history of diarrhea for a week. During the night, he had a diarrheal stool in his diaper. When his diaper was changed the next morning, his parents noted that he had a blister on each buttock that wiped off. No other injury was discovered.

Figure 13-103. *The location of the injury is consistent with the case history.*

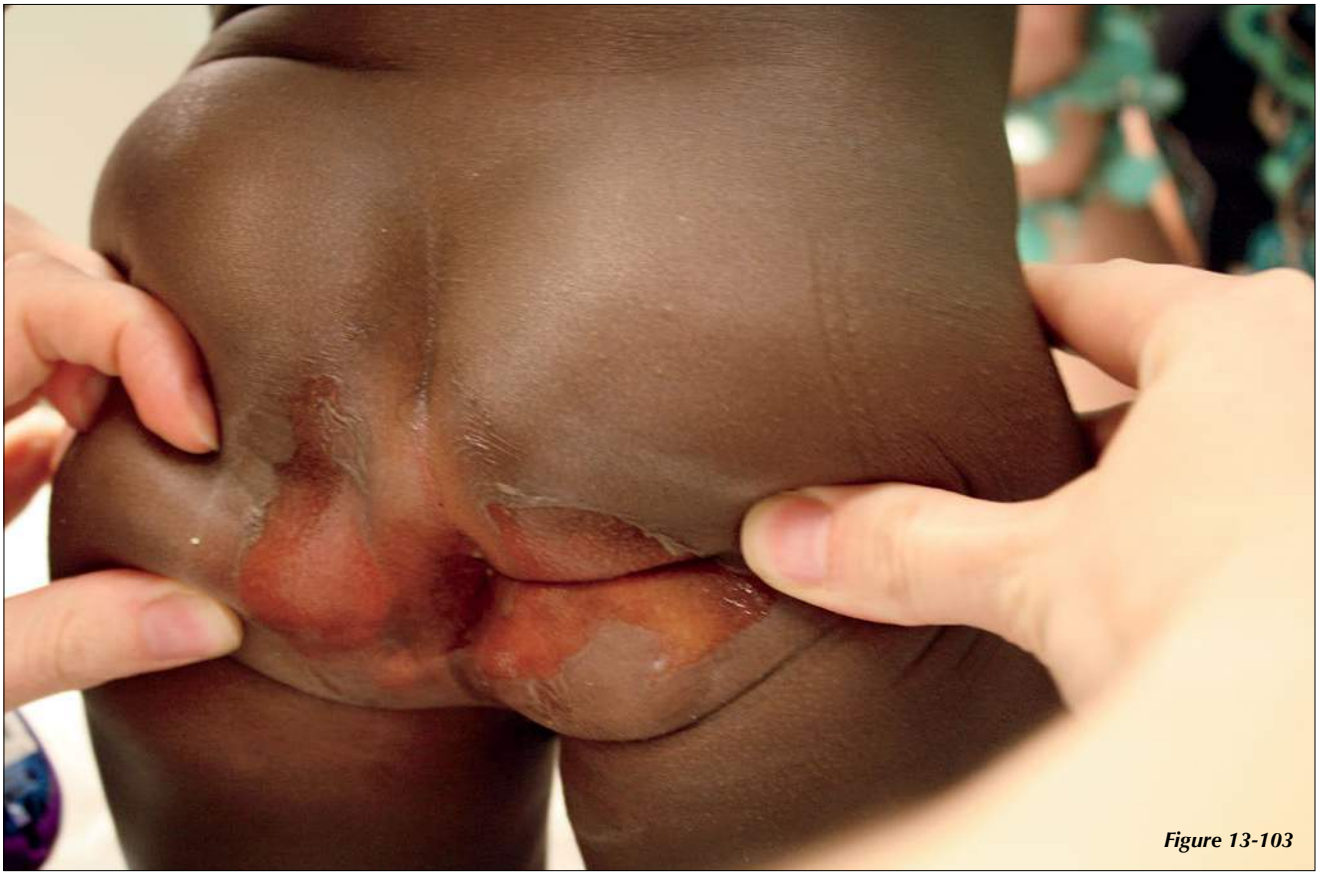


Figure 13-103

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