CHAMP

Maryland Child Abuse Medical Providers

Physician's Handbook

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Chapter 1. Introduction to child abuse assessments

Reading:

David TJ. Avoiding pitfalls when writing medical reports for court proceedings in cases of suspected child abuse. Arch Dis Child. 2004; 89: 799-804

A: Overview

The job of a general pediatrician calls for them to consider child maltreatment in appropriate situations, assess whether suspicion is reasonable, and report reasonably based suspicions to appropriate authorities. Depending on the situation and the individual, a certain amount of "work up" may be performed in evaluating suspicion for reasonableness, but there is no need to be certain of the maltreatment diagnosis before reporting the case. Another role is that of prevention. Parental education on normal growth and development, safe handling of babies and available community resources has long been part of high quality pediatric care, and helps prevent abuse. Screening parents for the risk factors of depression and domestic violence is a new role for pediatricians, but may contribute to the prevention of neglect and abuse.

A CHAMP physician must go beyond the responsibilities of the general pediatrician. In most cases, suspicion will already have been generated prior to the CHAMP physician's involvement. The goal of the CHAMP physician is to provide the best medical intelligence to the agencies that must protect maltreated children. A CHAMP assessment will be most helpful when it achieves one of three things.

1. The CHAMP assessment may result in a reasonably certain diagnosis of child maltreatment. Such an assessment should be complete and well supported. The manner of abuse should be specified or confined to a limited number of possibilities. Medical indicators to the timing of the abuse should be pointed out. The CHAMP physician should be aware of an evidentiary basis for these determinations, both in clinical experience, and in the literature. Reasonable differential diagnoses should be considered and excluded.

2. The CHAMP assessment may result in a reasonable exclusion of child maltreatment. Such an assessment requires an alternative hypothesis that explains the child's condition. A non-inflicted trauma or medical diagnosis should be evident that explains the findings, is consistent with the given history, and is either supported by clear evidence or significantly more likely than child maltreatment.

3. Finally, the CHAMP assessment may illuminate a remaining diagnostic dilemma. Available evidence may leave the CHAMP physician uncertain if an injury was inflicted or not. A list of plausible differential diagnoses is a reasonable outcome of a CHAMP assessment. It may be helpful to estimate which diagnoses appear more, or most likely. If a medical process can resolve remaining ambiguity, it should be elaborated.

B. Tools, process and product

The performance of this task will rely on three tools: the collection of subjective and objective evidence; knowledge of the epidemiology, mechanics, physiology and differential diagnosis of maltreatment; and an analytic method to merge evidence and knowledge and produce a reliable, valid opinion.

All this starts with a thorough history and physical examination. A structured encounter form will assist in thoroughness and reproducibility, but should not limit creativity nor confine the extent of examination or history taking. It is very difficult to get child abuse physicians to explain how they analyze the data and come up with their assessment. We will attempt to formulate a method, but this is not intended to restrict the experienced CHAMP physician who has developed their own clinical approach. The product will be a written opinion submitted to the consulting agency, typically child protective services (CPS). If opinions are not well expressed, legible and intelligible to the intended audience they are useless, or worse, misleading. If photographs or videos are ill composed, exposed or focused, they will not refresh the CHAMP physician's memory in court, or adequately convey findings to a social worker, police officer, attorney, outside consultant, judge, or jury member. Quality, timely documentation is as important as assiduous assessment and insightful analysis.

Chapter 2: Evaluating Sexual Abuse

Reading:

Kellogg N. The evaluation of sexual abuse in children. Pediatrics 2005; 116:506-512

Bernard D, Peters M, Makoroff K. The evaluation of suspected pediatric sexual abuse. Clin Pediatr Emerg Med. 2006; 7: 161-169

McCann J, Wells R, Simon M, Voris J. Genital findings in prepubertal girls selected for nonabuse: a descriptive study. Pediatrics. 1990; 86: 428-39

McCann J, Voris J, Simon M, Wells R. Perianal findings in prepubertal children selected for nonabuse: a descriptive study. Child Abuse Negl. 1989; 13: 179-93

Berenson A. Appearance of the hymen in newborns. Pediatrics 1991; 87:458-465

Berenson AB. A longitudinal study of hymenal development from 3 to 9 years of age. J Peds 2002; 140: 600-607

Myhre AK, Berntzen K, Bratlid D. Genital anatomy in non-abused preschool girls. Acta Paediatr. 2003; 92: 1453-62

BerensonAB. Appearance of the hymen in prepubertal girls. Pediatrics1992; 89: 387-394

McCann J. The appearance of acute, healing, and healed anogenital trauma. Child Abuse Negl. 1998; 22: 605-15

McCann J, Voris J, Simon M. Genital injuries resulting from sexual abuse: a longitudinal study. Pediatrics. 1992; 89: 307-17

Berenson AB, Chacko MR, Wiemann CM, Mishaw CO, Friedrich WN, Grady JJ A case-control study of anatomic changes resulting from sexual abuse. Am J Obstet Gynecol. 2000;182: 820-31

Heger A. Children referred for possible sexual abuse: medical findings in 2384 children. Child Abuse and neglect 2002; 26:645-659

Adams JA, Botash AS, Kellogg N Differences in hymenal morphology between adolescent girls with and without a history of consensual sexual intercourse. Arch Pediatr Adolesc Med. 2004; 158: 280-5

Kellogg ND, Menard SW, Santos A. Genital anatomy in pregnant adolescents: "normal" does not mean "nothing happened". Pediatrics. 2004; 113: e67-69

Bays J. Genital and anal conditions confused with child sexual abuse trauma. AJDC1990; 144: 1319-1322

Shapiro RA, Makoroff KL. Sexually transmitted diseases in sexually abused girls and adolescents. Curr Opin Obstet Gynecol. 2006; 18: 492-7

Lamb ME, Orbach Y, Hershkowitz I, Esplin PW, Horowitz D. A structured forensic interview protocol improves the quality and informativeness of investigative interviews with children: A review of research using the NICHD investigative interview protocol. Child Abuse & Neglect. 2007; 31: 1201

Sternberg KJ, Lamb ME, Orbach Y, Esplin PW, Mitchell S. Use of a structured investigative protocol enhances young children's responses to free-recall prompts in the course of forensic interviews J Appl Psychol. 2001; 86: 997-1005

Sjoberg RL, Lindblad F. Limited disclosure of sexual abuse in children whose experiences were documented by videotape. Am J Psychiatry, 2002: 159: 312-314

Friedrich WN. Normative sexual behavior in children. Pediatrics 1991; 88 456-464

Adams JA, et Al. Guidelines for medical care of children who may have been sexually abused. J Pedatr Adolesc Gynecol. 2007; 20: 163

Child sexual abuse is not the most common form of maltreatment, making up less than 10% of reported cases. Neither is it the form of abuse with the highest likelihood of medical findings, as over 90% of evaluated cases have normal examinations and laboratory tests. In many centers, however, sexual abuse is the commonest referral for a medical assessment of suspected child maltreatment. Given this mismatch, it makes sense that the medical evaluations not focus exclusively on finding evidence of abuse. In fact, for all CHAMP assessment, the abuse assessment should be a subset of a thorough evaluation of the child's physical health and a chance to refer for appropriate mental health evaluation and treatment.

A. The Medical History

Background Medical History: How much past and other history you take varies provider to provider and patient to patient. You may choose to get a complete past history, including a prenatal history; birth history; history of past illnesses, surgeries and injuries; and a review of systems, or to truncate your past history. As a minimum you will want to know whether the child has had any ano-genital symptoms, injuries, and procedures. Issues with elimination, including urinary tract infection, genital discomfort, discharge and bleeding, enuresis, encopresis, constipation, and fissures, must be elicited. For teens, a menstrual history should be collected. Some providers do this first, to cement the fact that they are a medical provider, before the history of current complaint, while others

follow the tradition of getting a history of current complaint, then filling in with appropriate past and other medical history. A family history should include the family constellation, the various domiciles in which the child resides and visits, and appropriate family medical history. Particularly sensitive aspects of the family and child history will be addressed later.

Adult's Event History: Ultimately there are additional things that you will want to know that will have to be obtained from an adult informant, without the child hearing. You may be able to get these details from the agencies who refer you the patient. If they have not been provided, however, you may have to obtain them yourself. This information includes behavior changes, behavior disturbances, and sexualized behaviors in the child, the occurrence of domestic violence and sexually transmitted infections in the family and observations that make one adult suspicious of another. The occurrence of prior sexual abuse events, and suspicions about voluntary sexual activity are critical when interpreting an exam. When a child has made a disclosure to a parent, elaborating how that disclosure came about will help you know how much weight to give it. When a parent witnessed something, the actual observations will allow you to contextualize the observations.

Child's History: Not everyone agrees on what roles physicians have in obtaining an abuse event history from the child. If possible abuse is being investigated, and designated forensic interviewers will question the child, it is best that they go first. They should share their information with the provider. The provider may then use this and ask the child for clarifications of particular medical significance. Some physicians believe that their diagnosis is more secure if they take their own history without relying on the work of others. The CHAMP physician will need to coordinate with the agencies they support, when defining the limits to taking the child's history.

If at all possible a child's history should be taken alone. When children will not separate from an adult, the adult should be prepared to be a neutral support, not answer questions, not reinforce answers, and not react emotionally. The adult should be seated in a way that he or she does not face the child. The child's medical history is not a forensic interview, but should nonetheless avoid mistakes that would raise questions of leading and suggestion. A sample of questions has been provided, and will be discussed, but creativity and flexibility to different situations is required. Finally, the physician must embrace the attitude that it is better to come out with no history from the child, than to ask questions that are or create the impression of being leading. A question is considered leading, if it encourages a particular response. Many direct questions commonly asked by physicians would be considered leading by this standard.

With this in mind, if you believe that taking a child's event history best serves the medical evaluation, we advise that you begin by re-introducing yourself to the child as a physician who takes care children. You may point out that you are not the child's regular physician, and that the child has been brought to you for special reasons. There is some evidence that telling the child you will rely on their answers to provide proper care, and eliciting a promise to provide truthful answers is helpful. Once the groundwork is done, ask the child why they are there to see you. As a prototype question, this is a good one.

It provides the child with no significant information, and cannot be answered in one word. If this very open question produces an on topic response, requesting further elaboration or continuation is the foundation of the best history taking practice. When this does not produce a response, providing a frame of reference, from generally shared information may help the child.

If the child made a disclosure to their mother, you may ask the child if they told their mother something special, or upsetting, and what that was. Similar questions may be framed if the child told a teacher, was questioned by a police officer, or was interviewed by a social worker. Once the child is on topic, the history may progress by building on known information and requesting a narrative elaboration. Some information may be needed for medical purposes, such as use of a condom, the occurrence of bleeding and pain, the occurrence of ejaculation. These questions can be phrased in novel ways to provide the child minimal information, thereby leaving the child to demonstrate their own experiences. Once the child has told you that they were touched with a penis, you may ask "did he do anything before that", 'how did that make you feel", "did anything get on you." Any positive answers require elaboration.

As a last ditch effort, option posing (multiple choice) questions are used. These must be neutral, and sometimes must provide an option for an unanticipated response. For instance, if a child says she was touched, a common follow-up question would be, what were they touched with. If no answer follows you might ask "were you touched with his hand, or his foot, or something else." The best response to any questioning is a narrative. The next best response is in response to a few options, or a framing question. Simple endorsement of a historian's direct question is of limited utility, although it can be strengthened if the child is given an opportunity to reject some postulates, but endorse others.

Beyond details of the abuse, the child may have physical and emotional complaints not elaborated in the conjoint or adult's portions of the history. When parent and child have been very communicative, a simple question "do you have any concerns about your health beyond what we have talked about so far" may suffice. When an adult is not present, a complete review of systems may be done with the child. For the non-disclosing child, going through the body asking two questions location by location may also create another opportunity to disclose. Asking about the head, eyes, ears, etc., including the genitalia and the anus, "how have your …. been" and "what things have happened to your …. that bothered or confused you" will produce a non-leading opportunity to hear about abuse and other health complaints. Be sure, when getting to the anus and genitals to solicit the child's preferred names for those parts.

For the adolescent, who is reporting sexual abuse, other questions need to be asked. A child's sexual history – consensual or not - is very important when interpreting the examination. Similarly, emotional consequences of abuse often lead to risk taking behaviors. Asking about tobacco, alcohol and drug exposure and use is important. Suicidal thoughts, plans and behaviors, self-harm such as cutting, burning and erasing, and runaway plans and activities should be elicited. The most common emotional

consequences of sexual abuse are depression and post traumatic stress disorder. Questions to screen for these outcomes may lead to referral or triage for limited mental health resources. Finally, we should not assume that the reported sexual abuse is the only, or even the most disturbing experience the child has had. Asking about other things adults have done that concerned the child, other abuse experiences, and acts of the accused abuser towards others may elicit reports of physical abuse, a second abuser, domestic violence or the sexual abuse of another child.

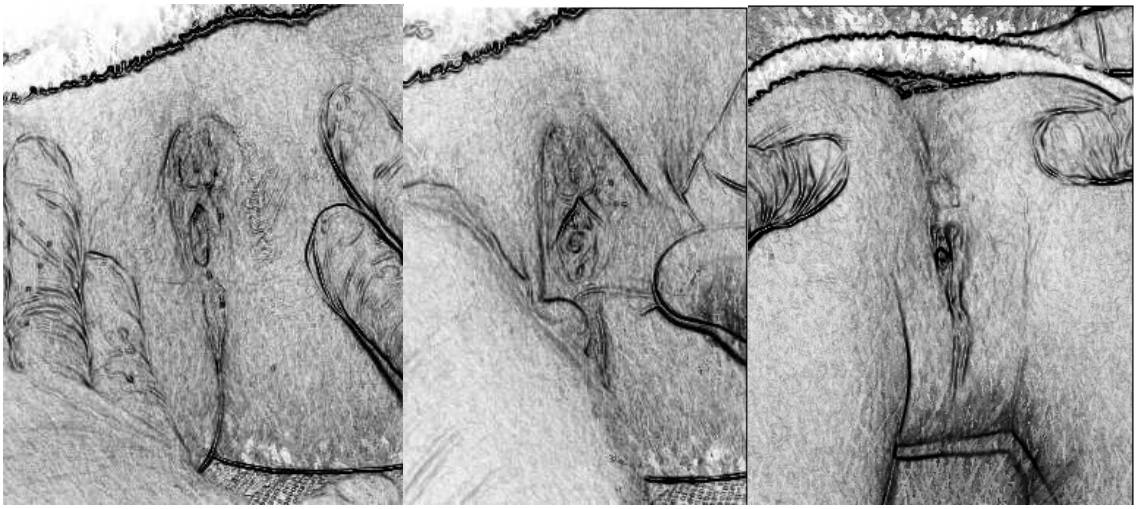
B. The Physical Examination

The physical examination of a possibly sexually abused child is a complete physical examination augmented by a thorough anogenital examination. There are many reason to perform a complete physical examination. Systemic signs of sexually transmitted infections, evidence of self inflicted injury, evidence of physical abuse, bites and hickeys from sexual abuse or activity are all important. Most important, however, is to cement the concept that this is a medical assessment of the child's well being, not an inspection of the child's hymen. Hopefully, this attitude will reinforce an approach established during the medical history.

General Examination: The details of a complete physical exam need not be listed here. Inspection of the skin, however, is particularly important. The neck, chest, breasts, back, buttocks, and thighs are often the target of scratches, bites and hickeys. If acute, these are not only evidence of oral contact, but may be swabbed for DNA and traces of saliva. Rashes of the palms and soles are a classic finding of secondary syphilis. Adenopathy may signal HIV, LGV, granuloma inguinale, as well as other conditions. Bruises, scars and hyperpigmented marks will be discussed in a future chapter, but may indicate physical abuse, or restraint during sexual abuse. The development of the breasts, and body hair are good evidence of sexual maturation, as many adolescents, boys and girls, shave pubic hair.

Female Genital Examination: In general pediatrics, a quick inspection for pubic hair is sometimes the only genital examination performed. Familiarization with basic normal genital anatomy is necessary before proceeding to genital examination. The labia majora are all that is commonly seen on simple inspection of the area. Once these are separated, the labia minora, clitoral hood, and posterior forchette are seen. In pre-pubertal girls the labia minora are poorly developed, and do not surround the introitus, meeting at the posterior forchette. In this condition, the forchette itself is not a discrete structure, but an area between where the labia majora separate and the posterior introitus. In this region, cutaneous tissue transitions to mucosa. Sometimes there is agglutination of tissues here, that may form a discrete translucent line, or an area of friability that bleeds following traumatic dehiscence. Within the introitus lies the urethra anteriorly, and the vagina posteriorly. Folds of tissue extend from the urethral area surrounding the vaginal orifice. There is great variation of these folds. Where they surround the vaginal orifice, they compose the hymen. The vagina itself, is not a simple tube, but has both transverse and longitudinal ridges that vary from child to child.

Examining these structures is usually begun in the supine position. For young girls, putting the soles of the feet together, with the thighs flexed, abducted and externally rotated, the so-called “frog leg position”, is the best way to inspect the genitals. For older girls, the use of the stirrups in traditional lithotomy position is preferred. In this position, the labia majora are inspected, then gently separated, with attention focused on the forchette region. The physician must be aware if they lyse labial adhesions producing bleeding, so that this is not mistaken for sexual trauma. Bleeding lesions of the forchette indicate recent trauma. The physician must be certain that they did not cause that trauma during the examination. Once the forchette is examined, the vestibule, including the periurethral structures, lateral vestibule, and fossa navicularis may be inspected for bruises, lacerations, abrasions, scars, vesicles, veruccae or other findings of significance. The hymen will likely be poorly seen with this technique, and the vaginal orifice may not open.



Supine Labial Separation Supine Labial Traction Prone Knee Chest

Grasping the labia majora between thumb and index finger, allows the examiner to draw them inferiorly and apart, the “labial traction” technique. Tension is carried through the tissues to the vestibule and vaginal canal, and will often open the vaginal orifice and display the folds of the hymen. With this technique, the contour of the hymen should be described circumferentially, with reference to the numbers of a clock face as an indication of location. Some hymens are circumferentially complete, or annular, but many have an anterior break, between the 11:00 and 1:00. Posterior to this break, the hymen should be uninterrupted, though it may be marked by narrowings and prominences. The area of most interest is the posterior rim, below the 3:00-9:00 line. A general sense of the dominant contour must be developed. Mounds, bumps and prominences above the dominant contour are normal, and the normal hymen between these elevations must not be mistaken for clefts, concavities, notches etc. When the hymen falls beneath the dominant contour in a focal area, a cleft, concavity or notch is present. Here we will treat these terms as synonymous. If a focal narrowing proceeds more than half way from the dominant contour to the level of the vaginal wall, it is called “deep.” If a focal narrowing proceeds to the level of the vaginal wall, dividing the hymen, a “transection” is present. At times the dominant contour of the hymen will itself

fall very close to the vaginal wall. This situation is described as a "narrow hymen." When the hymenal rim is less than 1 millimeter wide, from the vaginal wall to the free edge, it is markedly narrow. Caution, however, should be used when assigning all dimensions. The level of the vaginal wall is often difficult to ascertain. Measurements are difficult to make. Sometimes, when the hymen is absent over an extended area, a blunt topped ridge will be present. Many examiners would also consider this an absent hymen, sometimes referred to as a "speed bump." In very cooperative children, and adolescents, simple inspection of the hymen may be augmented by manipulation with a cotton tipped applicator. Moistening the swab with water or normal saline will lubricate it sufficiently, and reduce a burning sensation often perceived by pre-pubertal girls.

Any finding noted in the supine position needs to be confirmed with another position or technique. Though tension will tend to pull up the hymen, gravity continues to pull it down. Folds in the hymen account for much apparent contour variation, and may not be obvious as folds. Moist hymenal mucosa may stick to adjacent vaginal or introital structures, holding the hymenal rim down. Two alternative techniques attempt to resolve these issues. The first is the "prone knee-chest" position. The child is placed on her knees with the knees about shoulder width apart, and the buttocks high, above the knees. Then the upper chest is placed on the exam table, with the head turned to the side, and an ear on the table. The back should be lordotic, or "sway back". In this position, the thumbs of the examiner are placed in the fold between the buttocks and labia majora, with the fingers extending over the buttocks. The buttocks and labia are gently pulled superiorly and apart. If relaxation can be achieved, the vaginal will fall open, and the hymen will fall downward like a drape. Inspection of the posterior hymen is very much enhanced, and inspection of the upper vagina, even to the level of the cervix, may be made. Confirmation of supine findings and evaluation for previously unrecognized variations in hymeneal contour can be made. When the hymen continues to stick to the vestibular or vaginal walls, or will not unfold, filling the vestibule with saline or water is often helpful. The child is returned to supine frog-leg or lithotomy position for the final technique. Once again using labial traction, the examiner will slide the labia majora anteriorly, pulling up the forchette area as a dam. Saline or water is dripped into the cupped introitus, floating out the hymenal membrane. If a curved meniscus is formed, optical distortion will be noted. This can be dealt with by moving the labia and by draining and refilling the introitus with water until a good sense of the anatomy is achieved.

Male Genital Examination: Very little is written about the male genital examination. Male genital injury is more commonly due to physical than sexual abuse. The penis should be inspected for bruises, lacerations, and abrasions. Bite marks and suction petechiae may be related to oral sex. If a foreskin is present, and retractile, it should be pulled back to examine its under surface and the glans penis. The penile shaft should be inspected circumferentially. The scrotal sack is also examined for injury, and the presence of both testes in the scrotum is assessed. Unusual swelling or tenderness of the testes may indicate impact or crush trauma.

Anal Examination: When proceeding from the genital examination to the anal examination, careful inspection of the perineal body, and median raphe should be made. While bruises, lacerations or scars are occasionally seen, the nature of the raphe often has significant impact on the anal exam itself. The anus is best examined in one of the two "knee-chest" positions. Prone knee-chest was described in the female genital examination, and offers the best view of the anus. As an alternative, the supine child may grasp their knees and draw them to their chest, the "supine knee-chest position." Once in the position, traction on the buttocks, just outside the peri-anal tissues, can be used to separate the buttocks and encourage opening of the anal canal. Dilation of the canal must be kept track of. Immediate wide dilation > 2.0 cm is a notable finding. The width of dilation, persistence of dilation, and presence of visible stool in the rectal ampulla should be noted. Dilation that occurs only following traction is less notable, but the same observations are germane. The tissues surrounding the anus are again surveyed circumferentially with reference to the numbers of a clock face. Bruises, lacerations, abrasions, scars, tags, and vascular changes are noted. Normal depressions of the tissues are sometimes noted at the 12:00 or 6:00 position, the so-called "diastasis ani." The skin may seem thin, shiny and more lightly pigmented there. The median raphe may continue onto the anal verge with a mount, protuberance, or tag of tissue. These are normal structures. The condition of the verge itself will vary with relaxation. A tightly constricted sphincter will pull up deep folds, while folds will become shallow or flattened as the external sphincter dilates. If the external sphincter dilates, but inner sphincters constrict, a prominent ring at the verge or "tire sign" may develop. When sphincters dilate, the pectinate line may be exposed.

C. Assessment and Diagnosis

A diagnosis of child sexual abuse requires unequivocal medical findings and/or a clear, consistent, and credible account by the child. Greater than 90% of assessments produce no diagnostic physical findings. This does not prevent a diagnosis of child sexual abuse. A child's disclosure, with age appropriate detail, following non-leading questions may be adequate. The support of adult observations, including unprompted disclosure, behavior changes, and contextual evidence strengthens the diagnostic reliability of a child's statements to the physician. Physical findings may not provide independent corroboration of historical events, but should not be inconsistent with the reported abuse events. Under these circumstances, child sexual abuse is the predominant likelihood, and should be the premise directing further assessment and therapy. A diagnosis of child sexual abuse can be made.

Positive physical findings strengthen the diagnostic assessment. Acute anogenital injuries have been found to heal remarkably rapidly and completely. The presence of a bruise, laceration or abrasion, indicates trauma in the preceding days or weeks. This may support a matching history, suggest abuse that is undisclosed, or indicate other trauma. In particular, small lacerations between the peri-anal folds may be simple fissures from constipation rather than sexual injuries. Abrasions, bruises or lacerations of the labia, and forchette may be from straddle injuries. True scars are rare, and must be distinguished from normal variants. Diastasis ani in the midline has been mistaken for a scar.

Adolescents sometimes have depressed grooves in their fossa navicularis that may be mistaken for scarring. An avascular line through the mid fossa extending to the forchette commonly occurs and is called "linea vestibularis." This has been mistaken for scarring. Structures that fall neatly in the midline are likely to be normal variants. Bands connecting the hymen to the lateral vestibule, and the attachment of intravaginal ridges to the hymen have been mistaken for scarring. Clearly abnormal tissue, with a fibrous sub-cutaneous component may represent true scarring, and indicate past trauma.
The most common persistent finding, however, is a change in the hymeneal contour. Hymeneal transection in the posterior rim strongly indicates traumatic vaginal penetration. In most cases this will be sexual, but accidental penetration may have occurred and must be excluded. Deep notches (> 50% of the hymeneal width) posteriorly are good evidence of penetrating trauma in pre-pubertal girls. The data on post-pubertal girls supports significant concern as well, but this finding may not be as determinative. Absence of the posterior hymen clearly indicates penetrating trauma, but the significance of very narrow hymen (~1mm) is often debated.

Anal dilation that is immediate, persistent, greater than 2cm diameter and occurs in the absence of rectal stool is concerning, but debated. Venous pooling is a normal variant. It can be differentiated from bruising by having the child stand, and then repeating the exam. Bruising will persist. Very prominent focal vascular engorgement with blood, in young pre-pubertals, is controversial, and at most somewhat concerning. Tags on the anterior and posterior anal midline are common in normal children. Tags that are prominent, and away from the midline are much less common and may signal past trauma.

Sexually transmitted infections will be discussed more in the next section. A well established STI raises the possibility of sexual contact proportionally to the rate with which it is non-sexually transmitted. Outside the perinatal period, gonorrhea, syphilis, and Chlamydia are rarely non-sexually transmitted. Syphilis is a long lasting infection, so microbiological tests may remain positive for a very long time after perinatal transmission. Gonorrhea rapidly resolves following perinatal transmission, so identifying gonorrhea suggests sexual contact. The persistence of perinatally transmitted Chlamydia is incompletely understood. In the first three years of life, it is difficult to exclude perinatal transmission. Thereafter, Chlamydia is a strong indicator of sexual contact. HSV and HPV can be perinatally transmitted, auto-innoculated from non-genital sites, and transmitted during ano-genital care, as well as sexual contact. The occurrence of primary genital herpes and genital warts raises the question of sexual contact, but other avenues of acquisition must be considered. This is true for HIV as well, though the routes of non-sexual acquisition are limited and may be largely excluded during a medical history.

Beyond the diagnosis of sexual abuse, a complete medical assessment may identify other diagnoses. These need to be shared with the consulting agency, and with the child's care provider, so that the child's health is protected. While the CHAMP physician is unlikely to issue a mental health diagnosis, any indication of suicidality warrants an emergency mental health assessment, and indicators of significant risk taking, depression or PTSD

should prompt referral for a formal mental health evaluation. Confidentiality may be promised to adolescents regarding their drug, alcohol, tobacco and sexual practices, but suicidality must be disclosed.

D. Diagnostic and Treatment Plan

This section completes the standard SOAP approach to medical evaluation. Tests may be obtained to complete the diagnostic work-up or look for additional problems, and identified problems may require treatment.

A common concern is whether to order STI testing, and which tests to order. STIs are not common in sexually abused children affecting approximately 2-3% of children evaluated for alleged sexual abuse. An individualized approach is recommended. The presence of one STI in the patient, the perpetrator, or their family indicates the need to test for all STIs. Historical or physical evidence of penile penetration of any orifice signals the need to test that orifice for gonorrhea and Chlamydia. Symptoms of STI require evaluation with definitive testing. The definitive tests are: culture for gonorrhea, Chlamydia and herpes virus, serological tests for syphilis, HIV and hepatitis B, and pathological tests for HPV. Usually, a visual diagnosis of HPV lesions is deemed adequate. Trichomonas may be assessed by microscopic examination of a wet prep, but culture is both more sensitive and more specific.

If the CHAMP physician believes that the child has been abused, the child is disclosing abuse, or the child displays significant behavior disturbances, referral to mental health professional is required. Many sexually abused children benefit from therapy. Occasionally a child's history or abuse remains under question. Referral to a forensic psychologist or psychiatrist may help here. Protocols for extended forensic evaluation have been researched, and a provider specifically trained in one of these methods may be optimal.

It has been noted that past sexual abuse is common in the mothers of sexually abused children. Many of these women have never benefited from therapy themselves. Caring for a non-offending parent is a crucial part of caring for the child. Domestic violence, substance abuse, depression and past victimization must all be addressed.

The injuries of sexual abuse rarely require treatment themselves. Occasionally lacerations require suturing, and repair of a torn hymen has been attempted, but is controversial and rarely needed. Bleeding from deep in the vagina or anus must be visualized, and may require admission and examination under anesthesia. Sexually transmitted infections are treated, and their treatment is not further detailed here. Other medical problems may be identified, either from abuse, or incidentally. Appropriate treatment should be prescribed.

E. Conclusion

This chapter outlines a complete assessment of a child, who may have been sexually abused. Findings should be communicated to others to be effective. Communicating to the child and supportive adults that the child is or will be well, and steps to assure that outcome is paramount. Studies have shown that examination and discussion with the evaluating physician can leave a child feeling better about the normalcy of their body, and their well-being. Treating related and incidental physical health findings assures that well being. Appropriate mental health treatment increases the chances of long term mental health. Some people may believe that abuse is a catastrophic event that guarantees deep damage or even deviancy. This presumption must be countered, without undermining the incentive to seeking appropriate mental health help. Ending abuse, and protecting a child from repeat abuse are essential to recovery. This outcome cannot be produced by the physician alone. A well prepared written report to children's protective agencies, still or video images of important physical findings, and participation in multi-disciplinary teams all support this outcome. When necessary, the CHAMP physician must be prepared to provide well founded, convincing testimony in court.

Keeping up with changes in the field will be necessary to be able to serve the child, agencies and court in this fashion. Reviewing current literature, and attending professional meetings on this topic will help. To the maximum extent possible, CHAMP providers should photograph or video-tape their examinations and submit them to our peer review process.

Chapter 3: Evaluating Sexual Assault

Reading:

Christian CW. Forensic evidence findings in prepubrtal victims of sexual assault. Pediatrics 2000; 106: 100-103

Palusci VJ, Cox EO, Shatz EM, Schultze JM Urgent medical assessment after child sexual abuse. Child Abuse Negl. 2006; 30: 367-80

Centers for Disease Control and Prevention; Workowski KA, Berman SM. Sexually transmitted diseases treatment guidelines, 2006.
MMWR Recomm Rep. 2006; 55(RR-11): 1-94

Evaluating sexual assault has much in common with evaluating sexual abuse. In Maryland, abuse is by a caregiver or household member; assault is by others. A history of the events must be collected in detail, as details contribute to both the medical assessment, and to credibility in legal fora. Non-leading questions that elicit a narrative while providing reliable and valid information are the foundation of such history taking. The history must also include past medical and traumatic history, social, behavioral and emotional history. Taking an emotional and behavioral history in a time of acute crisis is difficult, and a follow-up assessment may be a better time to explore these areas. Differences between abuse and assault include a differing spectrum of assailants, the need to collect a forensic evidence kit, and the use of prophylactic medications. The assessment of acute sexual assault and collection of forensic evidence kits is not envisioned as a core activity for a CHAMP physician. Local circumstances may cause the CHAMP physician to consider offering these services in some situations.

A. What is Sexual Assault

The definition of what is abuse, and what is assault is defined differently in different settings. We will not attempt to put a definition forth here. For the purposes of this chapter, we will use the term “sexual assault” to mean acts of abuse or assault occurring within a time window that allows for the possibility of collecting a sexual assault evidence kit, and the provision of prophylactic medications. This window is defined by sexual acts and timing, not the relationship of the child to the assailant.

The traditional window for a forensic evidentiary exam, or “rape kit”, is 72 hours. Newer DNA detection techniques have extended this window, but studies in prepubertal children shorten it. When there is the possibility that semen was deposited on the skin, older techniques are effective for 48 to 72 hours. In the vagina of a post pubertal female, detection may extend out to 120 hours. In a prepubertal vagina or anus, however, detection after 24 hours is uncommon. By contrast, semen in the environment, on towels, clothing, bedding, carpets etc., is detectable for an extended period of time.

Prophylactic medication for pregnancy and STIs is provided to adolescent and adult victims of sexual assault. For the most part, these medications are most effective if given within 72 hours of sexual contact. Extension out to five or even seven days may be possible, but with decreasing efficacy. Pre-pubertal children usually do not receive prophylaxis. The exception to this is for HIV. The provision of HIV prophylaxis is somewhat controversial, but again a 72 hour window is allowed. We will return to these issues later, but together with the rape kit, these measures tend to draw a 72 hour window around the procedures discussed below. Other reasons to assess a sexual abuse complaint urgently are reports of pain, current apparent injury, bleeding, or symptoms of sexually transmitted infection.

B. Collecting the Rape Kit

Collection of a rape kit impacts the entire physical examination. Collection, and examination, begins when the child is first received. Sexual assault patients should be moved into a dedicated area as soon as possible, to avoid shedding evidence, and picking up traces from other persons and locations. Anything on the body of a sexual assault victim may be evidence, including but not restricted to, stray hairs, bits of dirt and plant matter, threads and paint chips, and residue from liquids or adhesives. Victims who have not bathed or changed their clothes are asked to stand on a drape, and disrobe, placing their discarded clothing in paper bags. They may then dress in scrubs or a hospital gown, and the drape is folded up for submission with the kit.

The actual examination begins with thorough inspection of the skin. Injuries are obviously important, but adherent material, stains, dried residues etc. are all important. Often this inspection is aided by use of an alternative light source. Cobalt blue light viewed through an orange filter is the current standard, and the old Wood's lamp is used as a last resort. Bites, hickeys, stains, and dried liquids are sampled with a moistened swab that is then labeled and set aside to dry. Adhesive residue and crusty dried material may be scraped into a paper envelope with a scalpel blade. Hairs, fibers and dirt may be lifted with cellophane tape then attached to a microscope slide or a card. Once trace evidence is removed, closer inspection of any injury or mark is performed. The presence of tenderness, with or without apparent bruising is also noted. All findings should be documented on a body diagram, and visible injuries should be photographed.

Following the cutaneous exam, a general examination is performed. At certain points additional forensic evidence is collected. Inspection of the mouth should look on the palate for evidence of petechiae or bruising inflicted during forced oral sex. If oral sex occurred, swabs are used to collect residue from the recesses and fornices of the mouth, rubbing in the recesses of the lips, under the tongue and around the base of the teeth. Some kits will call for the patient to chew a 2 X 2, saturating it with saliva, as a standard. Head hair and pubic hair are requested in many kits, and should be plucked. Sometimes this step is skipped so as to spare the patient. Patients can support this step by agreeing not to shave, color, or perm their hair. The pubic hair is also combed towards an open sheet, collecting any traces that comb out, and then the comb itself for inclusion in the kit.

The genital exam may begin in the same manner that the sexual abuse exam is performed. Prior to labial separation, a moistened swab is used to collect any residue on the labia majora, mons veneris, and perineal body. Labial separation and traction are used to evaluate the introitus for injury. Anterior, lateral and posterior vestibular structures are looked at in turn. Acute injury during sexual assault is commonest on the posterior forchette and the hymen, but labial injury, peri-urethral injury, and injury in the vestibule all occur commonly. These areas must be thoroughly visualized. A complex hymen may need to be "run" with a swab to look in all of its fold for injury. Injuries as extensive as laceration through the hymen, fossa navicularis, and forchette, and as minimal as a few petechiae surrounding the urethra may be significant. Following direct examination, swabs are collected. For the post pubertal girl, a speculum exam may be appropriate. This allows for collection of swabs from the posterior fornix of the vagina, and the cervical os. For other girls, swabs may be restricted to a blind swab of the vagina, or even limited swabbing of the forchette and fossa navicularis. The exam should be adjusted to the reported acts of the assailant, and the age, anatomy and tolerance of the patient.

The anus is also examined much as it is in the sexual abuse exam. Early in the process, swabs of the buttocks and the peri-anal tissues are collected. Following examination for lacerations, abrasions, and bruises, a swab of the anal canal and rectal vault may be obtained, as indicated by the history, and tolerated by the patient. If there are significant anal symptoms, following reported penetration, anoscopy may be performed.

If any cutaneous swabs were collected, a control swab from a similar but unaffected patch of skin is also collected. Blood specimens are also requested as a control. If there is any evidence of intoxication, in the history or in the examination, blood and urine for alcohol and drugs are collected. Date rape drugs, such as GHB, ecstasy, rohypnal and ketamine may not be detected in routine hospital toxicology, and require special handling. The kit itself must be packaged and sealed according to instructions. Kits are turned over to police investigators according to the "rules of evidence" with appropriate documentation.

C. Sexually Transmitted Infections

In the otherwise sexually inexperienced child, any sexually transmitted infection is important, and guidelines for testing, outlined in the sexual abuse chapter, should be followed. Some worry that a pre-existing STI may be used to embarrass or harass a victim, and choose not to test for diseases that will be prophylaxed anyway. We believe that patient care is best guided by full information, and recommend collecting gonorrhea, Chlamydia, syphilis, HIV, Hepatitis B and C testing on these patients. Prophylaxis is often given for gonorrhea (ceftriaxone 125 mg i.m., or cefixime 400 mg p.o.), Chlamydia (azithromycin 1 gm p.o.) and trichomonas (metronidazole 2 gm p.o.). HIV prophylaxis may be begun if the patient desires. HIV tests, CBC and liver function tests must be drawn first, and a three to five day supply of an effective two or three drug regimen

provided. Treatment is for 28 days, and so follow-up in an appropriate setting must be established before beginning this regimen.

D. Pregnancy Prophylaxis

If a pregnancy test is negative, prophylaxis against pregnancy may be given. Plan B is given immediately and again in 12 hours. This regimen has fewer side effects than older regimens, but must be started within 72 ours. The older regimens (Ovral two pills immediately and in 12 hours) may be effective out to five days following contact, but with decreasing efficacy. Informed consent should explain that these drugs may work by preventing implantation. Some families consider such a method to be abortion, and may choose to forego contraception once they understand.

E. Rape Trauma Syndrome

Rape trauma syndrome is a description of how women respond emotionally to rape. While this condition is well recognized in adults, it should not be applied to children. Some children may follow the pattern, but many do not. It is not unusual for adolescents to be unfazed, or apparently pleased with the attention they receive during a sexual assault assessment. Unusual combinations such as shyness about the cutaneous and breast exam, but ready accommodation to the genital exam are common. Presumptions about "normal" behavior should be set aside when assessing these cases.

F. Assessment:

Injuries documented during a rape assessment can corroborate a child's story of sexual contact, or suggest sexual contact in a non-disclosing child. In young children this is enough to establish that a crime has been committed. In older children who may voluntarily consent to sexual contact, physical findings may not be relied upon to make such a determination. Injuries have been shown to be both more common, and more extensive, following sexual assault than voluntary sexual activity, but significant overlap exists, and no physical finding can establish that a sexual act was not voluntary. The history and non-medical examination must be relied upon to determine whether contact was voluntary or assaultive.

G. Follow-up

Though the emotional response to rape may vary, there is a high probability of post traumatic stress disorder and other behavioral and emotional disorders following rape in children. Referral for mental health assessment is mandatory in all cases. Medical follow up of patient's two weeks after their initial assessment is also recommended. The healed state of the child's genitalia will be documented against the possibility that a second assault may occur. The child's compliance with prophylactic medications, and their effective prevention of pregnancy, and sexually transmitted infections are verified. Behavior by the child that contributed to the rape can be explored, and effective protection from family and community threats can be assessed. Finally, many children'

and their families, need follow-up and encouragement to follow through with referral to mental health services.

Chapter 4: Evaluating Cutaneous Trauma

Reading:

Sugar NF, Taylor JA, Feldman KW. Bruises in infants and toddlers: those who don't cruise rarely bruise. Pugeot Sound Pediatric Research Network. Arch Pediatr Adolesc Med. 1999; 153: 399-403

Labbe J, Caouette G. Recent skin injuries in normal children. Pediatr. 2001; 108: 271-276

Kos L, Shwayder T, Cutaneous manifestations of child abuse. Pediatr Dermatol. 2006; 23: 311-320

Mudd S, Findlay J. The cutaneous manifestations and common mimickers of physical child abuse. J Pediatr Health Care. 2004; 18: 123-129

Maguire S, Mann MK, Sibert J, Kemp A. Are there patterns of bruising in childhood which are diagnostic or suggestive of abuse? A systematic review. Arch Dis Child. 2005; 90: 182-187.

Maguire S, Mann MK, Kemp AM. Can you age bruises accurately in children? A systematic review. Arch Dis Child. 2005; 90: 185-187

Bruises, abrasions, lacerations and other physical trauma to the skin are the commonest physical findings resulting from child physical abuse. These injuries are also the most common physical findings resulting from accidental trauma. Distinguishing between the two causes is at some times obvious, and at others quite difficult. Epidemiological facts about cutaneous injury can help to raise suspicion in the youngest of children. Patterns apparent in visible injuries may provide readily identifiable evidence of the causative traumatic event. Whenever minor cutaneous lesions give rise to abuse concerns, a complete history, physical examination, and appropriate imaging and laboratory work up should be performed so as to fully understand the nature of traumatic events.

A. History:

When a child can give historical evidence in his or her own assessment, the child should be taken aside for an independent history. When multiple adult historians are available, interviewing them separately contributes to the assessment. Additionally, whenever information is provided, the source of the information should be ascertained. Information from direct observation must be distinguished from information that is inferred from circumstances and second hand information obtained from the report of others. Failure to do so may attach too great a weight to consistency or inconsistency between one history and another, or the physical findings.

It is good to request a trauma history both before, and during the physical examination. Taking a trauma history before the physical exam, provides no clues to patterns and locations of injury. This will make it harder to fabricate or conjecture explanatory trauma. Ultimately, the consistency and completeness of this history will be scrutinized. Bruises, however, may not develop until a day or so following the inciting trauma. As children become older, and more mobile, bruises may occur during independent activities, of which a caretaker may be unaware. During the physical examination, it may be good to again request an explanation for each important injury. This will give the historian clues to what we are attempting to explain, prompting memory, or creativity. We will later analyze variations in given histories.

The behavioral and developmental abilities of the child will be important when assessing the given trauma history, and when assessing the physical findings. The current motor abilities of the child may preclude the child's acting in the way the adult historian describes, forming a historical inconsistency. They may also convey surprising ability that raises the likelihood of accidental injury. The child's behavior may be quite passive and mild, explaining delayed recognition of pain and disability. It may also be difficult and challenging, explaining relational difficulties between a caretaker and the child.

The past history and family history should rest on a foundation of completeness. Still, certain topics are worthy of focus. Recent viral illness, followed by easy, or spontaneous bruising may signal immune thrombocytopenia. Weight loss, fevers, body pains, or pallor may indicate lymphoma, leukemia or other bone marrow disorders. Bleeding, bruising, surgical and dental histories provide an opportunity to evaluate for hemophilias. If the child is a boy, bleeding following circumcision may point to a bleeding disorder. For adult female relatives, a menstrual history, probing duration and flow may provide the only clue to von Willebrand's disease, the commonest of the hemophilias. A much less common concern is the possibility of collagen vascular disorders. Joint hypermobility, skin laxity, unusual paper thin scars, easy laceration, and difficulty retaining surgical sutures all point to Ehlers Danlos syndrome, and will impact on the injurability of skin.

The family social history is sometimes highly germane, but must not be over-interpreted. Domestic violence increases the likelihood of child abuse by both the assailant and the victim. The stresses of single parenting and poverty may increase the likelihood of abuse. Personal limitations may be evident as substance abuse, low education, or mental illness, further decreasing the caretaker's resources when faced with childhood challenges. Risk, however, does not demonstrate abuse. The recognition of risk helps to direct treatment for the abused child, and risk reduction of the non-abused child. When the evidence of abuse is equivocal, an assessment of risk may form the basis for resolving that uncertainty and developing a plan.

B. Physical Examination:

As with the history, the foundation of the physical exam is a complete clinical assessment. Rather than outline this complete exam, important and overlooked areas will

be stressed. Injury to the head is particularly important in young children, as they may be the only sign that a vomiting, somnolent, or irritable child suffers from intracranial injuries. Examination of the scalp can be pursued by inspection through the hair and by palpation. Bruises, step offs, swelling, tenderness or crepitance should prompt suspicion of significant impact to the head. Fine petechiae and alopecia may be evidence of hair pulling, particularly if short broken hairs are also found. Impact to the face may leave bruises outside, on the skin, and inside, on the oral mucosa. Look at the buccal and labial mucosa for bruises and lacerations from impact to the face. Other important oral findings are torn frenulae of the tongue and lips, and pharyngeal bruises and lacerations.

The eyes require careful evaluation. Ophthalmoplegia, inappropriate constriction or dilation, and non-reactivity to light may be a sign of cerebral injury. The sclerae may show petechiae and hemorrhaging from direct trauma, or from indirect effects of suffocation, strangulation, and valsalva. Inspection of the retinas of neurologically intact infants is often difficult. Direct ophthalmoscopy should be attempted, as retinal hemorrhages create great concern for intracranial injury. False positives are rare, though false negatives are more common, and a direct ophthalmoscopy should not replace indirect ophthalmoscopy whatever the result.

Examination of the body may proceed by complete disrobing, or serial disrobing of the body, but all body surfaces should be well inspected. Whenever a bruise is suspected several observations are relevant. A historian, or the child, may be asked for an explanation. Similarly, they may be asked if the mark is recent, like an injury, or long lasting, like a birth mark. Pressure on the lesion may elicit tenderness, in an injury, or blanching, in a vascular mark. Palpation will demonstrate whether the mark is over soft tissue, or a bony prominence. The color, shape and size of the bruise should be noted, diagramed, and photographed according to techniques that will be discussed later. Non-injured areas should be palpated as well. Palpation of the abdomen is routine, and any evidence of abdominal tenderness requires follow-up to rule out visceral trauma. Palpation of the rib cage may identify tenderness, swellings, and crepitance from underlying bony injury. Similarly, palpation of the appendicular skeleton may demonstrate tenderness, motion, crepitance, swelling or deformity from skeletal fracture.

Aside from acute injuries, other marks may be important to the assessment. Pigmentary changes in otherwise normal skin; changes in texture, with or without color change; and true scarring, with thickening of skin and disturbance of the sub-cutaneous tissue, all may persist as long lasting evidence of injury. Inspection, palpation, and manipulation of the skin are needed to distinguish these entities, and they should not be lumped together under the broad heading of “scarring.” Hyperpigmentation commonly persists in dark skinned individuals, following inflammation, burning, bruising, abrasion, and many other skin conditions. This is a result of superficial injury. The pattern may give specific indication of the inciting trauma, similar to the case with bruises, and this must be evaluated against the history to assess the possibility of abuse. Hypopigmentation, and textural changes usually result from deeper injury, to the basement membrane. Burning, cutting and deep abrasion are typically the cause. Spontaneous vitiligo, and striae must be eliminated in certain circumstances. A true scar, with changes in the mass and

elasticity of subcutaneous tissue, usually implies damage of subcutaneous structures with subsequent repair. Incision, laceration, or particularly deep burning or abrasion are implicated. The presence of unusual paper thin scars should also direct the CHAMP physician to consider Ehlers Danlos syndrome. The general nature of the skin is of interest as well. If the skin is loose and baggy, or if the skin is unusually elastic, Ehlers Danlos should be suspected.

Observations on growth and development will help assess the past health and nurturing of the child. A height or length, weight, and head circumference need to be measured and plotted. Obviously a single point is not as helpful as the growth trend demonstrated on a growth curve. The history, or review of past records will aid in evaluating growth parameters. The developmental abilities of the child should be independently confirmed where possible. Motor abilities inconsistent with the explanatory trauma history create concern for fabrication to hide abuse. Developmental delays will require addressing, whatever the abuse assessment. Delays in language development are very common in abused and neglected children, and must be addressed in the child's care plan.

C. Imaging and Laboratory Investigation:

The laboratory investigation is designed to look for occult injury, and to explore a differential diagnosis to inflicted trauma. Coagulopathy screening is the most frequent recommendation. Screening is not usually recommended if the only finding is a clearly patterned injury, such as loop marks. When the case is based on "too many bruises", when there is a pertinent child or family medical history, or when there is internal bleeding, a coagulopathy will be required, whatever the bruise pattern. A complete blood count with platelet count, PT, INR, and PTT are routinely ordered. This screen, however, is incomplete. Many would add a von Willebrand's panel to evaluate for the commonest form of bleeding disorder. The presence of petechiae may suggest a platelet disorder, and platelet aggregation studies might be appropriate. Thrombin time, fibrinogen, and factor VIII, IX, and XIII, have all been recommended, but usually for severe internal bleeding. Coordination of this work-up with a hematologist is preferred.

If a child appears to have been recently beaten, laboratory testing will add to the sensitivity of the examination for internal injuries. ALT and AST testing improve the sensitivity of the clinical exam for liver injury. These enzymes rise and fall rapidly, and may be unhelpful several days after the incident. Amylase and lipase increase the ability to detect pancreatic injury, and urinalysis contributes to evaluating renal injury. Amylase takes time to rise, so testing less than four hours following the traumatic incident may miss the injury. Testing urine and stool for occult blood may help detect occult abdominal trauma.

Deep muscle injury may occur with extensive forceful beating. Myoglobinuria may be detected as a color change, or as heme positive urine with no red cells. Testing the blood for CPK and myoglobin will demonstrate deep muscle necrosis. Additionally, myoglobinuria may result in renal failure, and so merits special acute medical management.

Genetic testing is available for collagen disorders such as Ehlers Danlos syndrome. Blood and skin biopsy sample based tests exist. While the need to perform a skin biopsy will obviously give the family and practitioner pause, neither test should be performed without a clinical indication based on the history, family history or physical examination.

The skeletal X-ray survey is recommended for all suspected child abuse cases under age two years. We will discuss this imaging modality in more detail, later. Certainly children under age two with suspicious bruises are candidates for a skeletal X-ray survey. The finding of occult injuries has great significance. If the exam produced concern for skeletal injury, the region of concern should be explored radiologically, whatever the child's age.

Computed tomography of the head has been recommended in very young infants with suspicion for child physical abuse. Infants under one year of age, with contusions of the head and face or skeletal injury, and infants under six months of age with any evidence of physical abuse are most likely to have intracranial injuries found on screening evaluation.

D. Assessment and Diagnosis:

Once again, a diagnosis of child abuse will rest on direct evidence that abuse has occurred. Bruising and pigmentary marks may display patterns that reflect the inciting contact. Bruising in the shape of a hand bespeaks a slap. Parallel lines of bruising may outline the impact of a board, belt, or cord used to whip the child. Clusters of oval bruises may correspond to the finger tips of a grasping hand, or the knuckles of a fist. Many such patterns have been recognized. Each tells the tail of inflicted injury. Barring a convincing and physically consistent history, abuse must be suspected whenever there is a pattern. Classic patterns such as belt marks, loop of cord marks and slap marks effectively document abusive injury.

Another sort of pattern speaks of child abuse. The battered child syndrome is a pattern of multiple independently occurring injuries that are ill explained and unusual for the child. This pattern rests on the idea that when a single unusual and ill explained injury occurs, abuse is suspected but unusual other events cannot be excluded. The repetition of such a circumstance however, suggests abuse, which tends to be repetitive, rather than unusual circumstances that should not arise repeatedly. Injuries may be judged to be independent on various grounds. A fracture with evidence of healing, and a new bruise likely occurred at differing times. If the fracture is of the ribs, and the bruise is on the face, they occurred in different locales. Even two skin injuries may be distinguished if their locations indicate they must have arisen from two separate blows. Finally, different traumatic mechanisms, such as a burn and a blow, would be judged to be independent.

There has been a tendency, in the past to "date" bruises, so as to label them separate events, and fix them in time. Charts of color change in bruising, with proposed age criteria have been published, and various charts are internally inconsistent. Recent research has shown these schemes to be inaccurate, and physician assessment of bruise

age to be inexact. Yellow coloration will not be seen in a bruise until at least 18 hours following injury, but a red color may persist throughout the life of a bruise. Two bruises of the same generation may have very different appearances. While a CHAMP physician may have some feel that one bruise is very recent, and another is very old and resolving, more exact comment on age, and differentiation should not be made.

There was earlier reference to ill-explained, and unusual injuries "for the child." A knowledge of what injuries are expected in children, and of normal child behavior is necessary to make such a determination. Young infants very rarely manifest any bruising at all, but may have short shallow abrasions, usually of the central chest and face. These abrasions should be consistent with scratching by the short soft nails of the infant itself. As the child begins to pull to standing, and walk along objects, he or she will begin to fall and collide with objects. There are very seldom more than five bruises on a single child, and bruises are typically oval, anterior, and overlying bony prominences. The forehead, scalp and anterior shins are the most common locations for such injuries. Walkers bruise more commonly still, with a greater number and extent of bruising. As many as half of toddlers will have bruising, with up to eleven bruises per child. Still, the great majority of bruises are found over the knees and shins, and bruises should be predominantly oval, anterior, and over bony prominences. Children at this level of ability get around, and into trouble, beyond the direct observation of a caretaker. Even a diligent caretaker will not be able to explain each injury. In general, the more severe the injury, the more expectation there should be of an explanation. When injuries do not tell a specific tale of abuse, and are not part of a pattern of repetitive injury, but remain ill-explained and unusual, suspicion of abuse remains, even though a firm diagnosis may not be made. As in much of medicine, the gray zone is quite big.

E. Diagnostic and Treatment Plan:

The great majority of cutaneous injuries heal well on their own. Bruises resolve over about two weeks time. More extensive injuries may take longer, but extended persistence should raise the possibility of another diagnosis. A plan for re-examination may assist when the nature of a finding is in doubt. Evolution and resolution is expected for all bruises, but is much slower for congenital lesions such as hemangiomas and nevi. Distinguishing traumatic pigmentary lesions and scars from pigmentary birth marks, striae etc. is harder, as each are long lasting. Re-examination will allow the CHAMP physician to do some library research, get some consultation, and take a second look.

Deep muscular injury, with myoglobinuria, requires hydration and monitoring to protect the kidneys. Evidence of intracranial or visceral injury will require additional imaging, observation, and sometimes surgery.

The presenting injuries are often only the tip of the iceberg. They are unlikely to tell the CHAMP physician the full extent of neglect and emotional abuse that has accompanied the physical treatment. These are highly damaging forms of maltreatment. Additionally, severe corporal punishment may be more likely in situations where the child has an underlying behavioral or developmental problem. A thorough assessment of behavioral

and developmental issues is warranted in all of these children. Speech and developmental delays have been found quite commonly in abused children. Referral to the "infants and toddlers" or "child find" program is highly desirable, and mandated by the state.

Many of these families re-unify rapidly? Fewer than 1 in 5 substantiated cases involve out of home care. Therapy directed at the parent, to manage child behavior, has the greatest body of research evidence for efficacy in these situations. Ongoing domestic violence both damages the child directly, and undermines other therapeutic plans. Domestic violence must be ended, and appropriate individual and family therapy initiated. Substance abuse is another related condition that must be addressed.

F. Conclusion:

Physical abuse is a common reason for referral by CPS, and cutaneous injuries are the most common presentation of physical abuse. Unlike sexual abuse, these injuries are always physically apparent, creating an object for examination, and for discussion during the history. Unlike sexual abuse, accidental injury is a significant likelihood to be differentiated. Like all forms of maltreatment, a medical approach, relying on subjective and objective data, and careful consideration of a differential diagnosis within a holistic consideration of the child best leads to an appropriate diagnosis and treatment plan.

Cutaneous findings create a particular burden on documentation. Thorough record preparation has been stressed previously. Diagramming injuries, with comments on measurement and color is a common supplement to the written note on these patients. Finally, photographic evidence is expected to accompany these cases. While CPS and law enforcement may take photographs, the CHAMP physician should not rely on those images unless the physician has seen the images and knows them to be both excellent and fully representative of what they see with their own eyes. When cases go to court, the CHAMP physician can expect to be confronted with photos, and asked if they are a "fair and true representation of what you saw that day." Positive steps should be taken by the CHAMP physician to assure they can answer that question, "yes." With that in mind, our next chapter will discuss photography.

Chapter 5: Photographing Injuries

Reading:

Ricci L. Photographing the physically abused child. Principles and practice. AJDC 1991;145:275

It is tempting to think that an expensive camera is necessary to take good medical photos. For the most part, this is not true. Good photography starts with the photographer, not the camera. There are many camera choices available. For the sake of this discussion, we will assume the use of a digital point and shoot camera with some advanced features.

A. Which Camera

We are finally reaching the point where increasing megapixels is not the great advance it once was. Even a three megapixel camera can produce a respectable 8X10 image. Virtually all the cameras you will look at will have at least five megapixels. There is little reason to pay more to increase camera resolution, other factors are more important. The features we will regularly use are, macro focusing, forced or suppressed flash, focus lock, and spot metering. An auto bracket feature may be helpful as well. The ability to rapidly access these features, long battery life, a quick shutter response, and overall ease of use will determine the right camera for the job. Also, do not forget to buy a large megabyte storage card that fits our camera. Remember, different media fit different cameras.

We will use the following procedure for taking photographs, prepare, compose, focus, expose, review, repeat. Each step is important, and having a routine will mean better photos.

B. Prepare

Both the subject and the camera must be prepared for imaging. We will attend to the camera first, because it does not lack patience. Have a fully charged battery and storage media with available storage space in the camera. Turn the camera on. Be sure all of the settings are what they should be.

Macro Focusing	ON (tulip symbol)
Focus Area	Locked
Metering	Spot
Flash	Forced Flash (lightning bolt without “A”)
Auto Bracketing	See text

More advanced settings must be individualized camera by camera. The settings menu of many digital cameras may allow you to adjust white balance, color saturation, and in camera image sharpening. Usually, these are left at the default settings. You may find, however, that changing these produces more natural skin tones, or sharper images. Careful experimentation may enhance your photos. When experimenting, however,

return your camera to a "fail safe" setup before storing. You do not want an unsuccessful experiment to be set when your next patient comes in.

The patient must be prepared for imaging as well. Consent is not required to image findings that may provide evidence of child abuse. If you are taking photos of an interesting non-abuse findings, however, consent should be obtained. Additionally, the child must be cooperative, and so the assent of the patient is important. A cooperative patient can be placed in a position where the finding is exposed and well lit. A blue towel or drape forms a good background, and helps the camera properly expose the skin. Finally, a sticker or card with a size standard, typically a ruler, and the patient's name should be placed in the field of view. The AFBO L shaped ruler is the most commonly used implement for photographic size standards. More convenient stickers may be obtained from police supply catalogues. Sometimes a color standard is recommended as well. These are harder to obtain, and may be dispensed with if the CHAMP physician will be testifying to their own photos.

C. Compose

The most accurate image will be obtained if the plane of the camera's CCD, the plane of the lens, the plane of the size standard, and the plane of the patient's skin are all parallel, and the size standard is the same distance from the camera as the injury. This is hard to arrange when the skin surface is curved, and the injury is large. As long as the plane of the camera, and the size standard are parallel, multiple images should be taken, from a variety of angles, to deal with curved skin and large injuries. The size standard must always be at the same distance from the camera, as the most important part of the injury.

In general, it is good not to focus in too close, too soon. A backed off view of the body, with the injuries visible, will help locate the injury on the patient as a whole. Then the CHAMP physician may move in for a regional view, and ultimately for a tight close up of important details and measurements. Some cameras take better macro images by moving in very close with the zoom lens at wide angle settings. Unless this is so, however, it may be better to zoom in using the optical (not digital) zoom. Long lenses shot from a distance give less distortion and better focus edge to edge than short lenses moved in close. Too close a flash distance may wash out an image as well. Experimentation before hand will make the CHAMP physician a better photographer, and it is always a good idea to do it both ways, if you have the opportunity.

D. Focus

Autofocus is certainly the best option in a digital point and shoot. While manual focus is available, trying to measure the distance from the camera to the subject, or focus by eye in the LCD screen, are not acceptable options. Because medical photographs often call for moving in close, the macro-focusing mode should be engaged. There may be a button on the camera, or you may need to move through menu screens to engage this feature. Typically it is marked with a picture of a tulip. The default auto-focus mode in most cameras, calls for the camera to analyze the image and automatically pick a focal point.

When the camera picks wrong, you must either try again, or be surprised by a blurry photograph. Cameras may let you lock the focus area, and this option should be taken if available. You may lock the focus to the center position, or, in some cameras, you may choose from an assortment of focus point locations on the screen. Cameras have a hard time focusing on wide areas of skin. A locus of sharp contrast will make it easier for the camera to focus properly. If the focus point is aimed at the edge of the size standard, the shutter release may be pressed halfway to engage and lock the focus. Then the image may be re-composed, while holding the shutter release half way down, and the picture taken.

Depth of field is the range over which the camera is in sharp focus. When depth of field is narrow, the focal point may be very sharp, but portions of the photo that are a little closer or farther from the camera are blurry. If this is a problem, switching the camera to aperture priority mode will allow you to choose a smaller aperture and increase the depth of field. Aperture is indicated by the f-stop number. A large f-stop number indicates a small aperture and will give a greater depth of field. Shooting at f 16 or f 32 will result in a large depth of field. It will also result in a slow shutter speed, increasing the risk of camera shake.

Not all blurry photos are the fault of poor focus. Motion artifact also shows as blurring. Having a still patient and a still hand helps. If motion artifact is an issue, switching the camera to a shutter speed priority, and taking the picture at a high shutter speed will help. Be careful, as increasing the shutter speed above the "flash synch" speed will produce poor results. This choice will also force the camera to use a wide aperture, making depth of field less. Finally, when pushing the shutter button, brace your arms against your body, your body against a large object, hold your breath, and squeeze slowly and smoothly, don't jab at the shutter release.

E. Expose

Once again, letting the camera choose exposure settings with the automatic or program exposure mode is usually the best option. Another metering option is between matrix, center weighted or spot metering. Matrix metering is like auto focus zone. The camera will analyze the whole image area and choose a compromise exposure setting. In this situation, a white drape or light clothing may cause under-exposure of dark skin. As long as the most important part of the image is kept to the center, spot metering will ignore the rest of the field of view, and expose the most important area the best. For this reason, spot metering, or if it is not available, center weighted metering is the best choice.

Flash is usually the best lighting for natural appearing skin tones, and good even light. Cameras often choose whether or not to fire the flash. Setting the camera so that the flash fires every time is the preferred option for medical photography. In some cameras, this is not available in auto-exposure mode. An alternative "program" mode gives more control and allows you to force-fire the flash. The flash will still automatically adjust its output. If the room is very brightly lit, the flash will fire less. In this circumstance incandescent lighting will give an overly red skin tone, and fluorescent lighting will give an overly

green skin tone. Reducing the room lighting will let the flash dominate more. When the camera is very close to the skin, the flash may not be able to reduce its output enough, resulting in washing out of the image. Putting a small piece of tissue paper over the flash will decrease and diffuse the light, often giving a much better image.

F. Review

The beauty of digital cameras, is that photos are available for immediate review. It is often difficult to identify weaknesses in an image on the cameras small LCD screen. While reviewing images, the zoom function will allow you to enlarge the on screen view, and the cameras four way controller will allow you to move around the image. With these features you can look at the most important parts of the image to assure that you have gotten the right exposure, and good sharp focus. When there is any doubt, it is always good to do it again.

G. Repeat

Excellent photographers shoot a lot of images and throw most of them away. Repeating is a sign of high ability, not low. Additionally, repeating gives you the chance to experiment. You may re-frame the image, change the angle, etc. The most common reason to repeat images is to "bracket" the exposure.

Bracketing means taking photos at both higher and lower exposures than the ones recommended by the camera. Digital cameras provide two ways of doing this without leaving the auto-exposure mode. The first is the Ev adjustment. Some cameras make this easily available, while others make you engage a series of menu screens. This adjustment lets you expose above and below the recommended exposure level. Typically this is referred to in "stops" Exposing 1 to 2 stops above and below the recommended setting will give a wide range to choose from. Some cameras offer an auto bracketing mode. In this mode a series of three or five images is taken, a predetermined number of stops above and below recommended exposure. All the images are saved, and you will be able to choose the best one during later review. Finally, some newer cameras have a "best shot setting". In this setting, the camera takes a series of shots, evaluated them and saves the best one. Usually this is not a good substitute for the other options.

H. Special Circumstances

Special problems call for special solutions. Occasionally the above advice must be abandoned, or novel measures are necessary. Flash gives great light, but tends to flatten elevated skin findings. Lighting from the side, will make an elevated scar pop out. Advanced systems allow you to take the flash off and fire it from the side. For the point and shoot, suppressing the flash (lightning bolt in a circle with slash) and using an exam light shined from the side will achieve this effect, though color may be different. Sometimes scaly or "ashy" skin makes seeing a subtle mark difficult. Wiping the skin with a moist paper towel will often suppress this problem. This creates problems of its own, as wet skin is very shiny. As the water evaporates a balance can be achieved

between the two issues. This will take patience, however. As mentioned above, when the flash is too bright, putting a small piece of thin white paper over the flash will diffuse it, and give a better effect.

I. Conclusion

If you carefully prepare, compose, focus, expose, review and repeat, you are likely to get good photos. Often these will be better than those provided to you by other sources. If you also play with the camera, and experiment, you will become an even better medical photographer. Eventually the equipment, not the photographer, will become the limiting factor. At that point, it may be time to move up to a digital SLR, medical macro lens, and ring flash, or other set-up. Such a set-up, however, can overwhelm the beginning medical photographer. We do not recommend this equipment as an initial purchase.

Chapter 6: Evaluating Burn Trauma

Reading:

Feldman,KW. "Child Abuse by Burning" in The Battered Child, 4th Ed. Kempe & Helfer, Eds. 1987, Univ of Chicago Press, Chicago,Ill: 197-213

So far, we have been talking about children who may be brought to the CHAMP physician's office for diagnosis and care, and needn't be sent elsewhere for inpatient or subspecialty care. Some burns fall into this category as well. The patient may be brought to the CHAMP physician as the first medical contact, and the CHAMP physician may both consult for the requesting agency and provide care for the child's medical needs.

Some burn cases, however, are brought to emergency departments and admitted to the hospital, or transferred to children's hospitals and regional burn centers. This is the first situation we have mentioned in which the CHAMP physician may need to consult for a requesting agency, in the absence of direct contact with the child. Such situations are often difficult. The CHAMP physician will be dependant on the recorded medical history of other providers, photographs of the actual injuries, and cooperation between local investigators, and distant medical providers in obtaining laboratory and imaging studies. Despite these limitations, the CHAMP physician can be of great assistance to local investigators in understanding what is going on with the child's medical care, and in communicating with medical systems that provide that care. The limitations, however, must be taken into account when rendering any opinion and preparing a report. Arguing a point from the records of another provider is not as secure as making the point from your own assessment. There are likely to be gaps in your knowledge of how history was obtained, and what was actually said. You may have to rely on drawings, photographs or descriptive reports, in place of performing an examination yourself. Such limitations must be acknowledged, and caution is warranted.

A. History:

The history, in a burn assessment, is similar to that of a bruise assessment. A complete medical history is taken. The events leading up to and resulting in a burn event are obtained in detail. Where no burn event is reported, all events of the days preceding the recognition of the suspected burn are reviewed. The evaluation of burns, however, may call for unusual details. In the case of tub and tap water burns, the state of the plumbing may be as important as the state of the child. Was a child's bath being run as the first use of plumbing after a cold night, or had three other people taken a shower before preparing the child's bath? Was a dishwasher running adjacent to where a child was burned in a sink bath, and does that dishwasher discharge into the sink drain? Does the tub water control use two rotating handles or a single central handle? Did someone flush the toilet, or start a washing machine, while hot water was running on the child? Similar issues come up with clothing iron burns. What was the setting on the iron? Does it have an auto-off feature if left unattended? How much time passed between when the iron was turned off, and the burn occurred? When a cigarette burn is suspected, it is important to

know if there are smokers in the home. When a burn is suspected, but no burn event is reported, the fact that the family was playing in the sun and drinking lime based fruit drinks can be important. Photophytodermatitis is a skin condition that may redden, brown or blister skin when lime or other fruit juices are on sun exposed skin. Patterns, such as hand marks or cup rims may be seen as suspicious. Some of these details can be logically anticipated, but others are idiosyncratic, and do not seem important until the right question is asked. A far reaching history is the best preparation for subsequent considerations.

B. Physical Examination:

Again, it is unnecessary to delineate here every aspect of a complete examination. Many burn evaluations make use of the same examination and documentation techniques discussed in the bruising and photography chapters. We will confine the discussion to certain findings. When a cigarette burn is suspected, the condition of the nares, and throat may have special significance. Bullous impetigo has been mistaken for cigarette burns, and is the most common medical condition mistaken for physical abuse. Rhinorhea and crusts about the nose, or exudative tonsillitis raise the issue of strep or staph, though their absence does not rule out impetigo. The presence of fever and general illness may signal an underlying illness. A febrile infant with erythroderma and a positive Nikolski sign may have scalded skin syndrome, and a sick febrile adolescent female may have toxic shock syndrome.

Burns are generally divided into fluid burns, and contact burns, meaning contact with a heated solid. Fluid burns may be identified by their ability to follow the curves and crevices of the body. Often the burn is of uniform depth, though drip marks may be found to have decreasing depth as the fluid dripped and cooled. Small islands of burning surrounding an area of larger contact may be from a splash, and scattered islands of burning distributed about a denser center usually signal splatter. When burns involve a complete extremity or the entire lower body, ending in a sharp demarcation, it may be possible to position the child such that the burn edges align on a single plane. This phenomenon is called the “high tide mark” and indicates that the child was immersed into hot fluid up to a level, making that “high tide mark.”

Areas of sparing within the immersed tissue may be caused by body parts pressing together, or being pressed against the vessel that contained the hot fluid. In this way the position of the child, during the burn event, may be reconstructed. If it is a natural position, then the CHAMP physician must consider whether the child could have gotten themselves into the situation. If the position is unnatural, or does not allow for self support, then the child must have been placed in the situation.

The presence or absence of splash marks has been given great significance. Certainly a flailing child, trying to escape may put extremities in and out of the fluid, and splash the fluid on non-immersed body parts. A clear border without splash marks is very suspicious, but, an inflicted burn may involve some splashing as well. The presence of splash marks do not eliminate abuse. There have also been anecdotes of children

freezing when only their legs or feet are being burned, causing a “high tide” mark, and no splashing. Splash marks help to recreate the burn event, but do not by themselves fully distinguish abuse from a non-inflicted burn.

When fluids are spilled, they invariably fall downward. If the volume is small, they cool and lose the ability to burn as they fall. By looking at burn distribution and depth, and considering falling fluid, it is often possible to recreate the position of a child during a spill burn. If a right arm and axilla, face, left shoulder, and anterior or posterior trunk are burned, we might imagine a child reaching up with their right hand, while looking at a pot they are about to pull off of a stove. If the back of the neck, top of the head, both shoulders and lower chest are burned, we might imagine a child looking down and hiding their face, while coffee is thrown at them. In both cases, lesser burns of the abdomen and lower extremities, with drip patterns might be expected.

When a heated solid touches the skin, it will leave an image of where it contacts the skin, so long as it does not slide during contact. A full sole print of an iron means that the iron was pressed hard enough to flatten the curves of the skin and make full contact, without sliding. Such an imprint suggests inflicted injury, unless a history provides for exactly such a contact. A partial imprint, with a sharp edge or stem vent, however, only means partial contact without motion. Given how fast a steam iron can burn, this may occur during a fast bounce. A history still must explain such a contact, but it would be easier to accept an accidental scenario under such circumstances.

Just as with bruises, multiple injuries will be looked for. The presence of multiple unexplained injuries in young children forms the “battered child syndrome” and strongly suggests child abuse. When multiple dry contact burns occur, it is harder to explain with a single accident. When burns occur on the body, such that contact with a single large surface could not explain them, they are said to be on “multiple planes” of the body. Usually this means multiple injury events, though every given history must be evaluated on its own merits.

C. Burn Scene Investigation

An investigation of the scene may be helpful in many abuse evaluations, but nowhere is it more important than with burns. The CHAMP physician may not go to the scene of the injury, but must coordinate with investigators who will, both before and after the scene investigation. Let’s review a case that demonstrates all aspects of a well evaluated scene.

A child presents with second and third degree burns of the lower extremities, perineum, buttocks, low back and low abdomen. This is recognized as an immersion burn, with a sharp high tide mark, and no splashes. There is sparing of the anterior and medial flexural creases of the thighs, behind the knees, and in a belly roll. The medical staff positions the child in such a way that a high tide line is readily seen. In this position, the distance from the lowest part of the child, to the high tide mark, is eight inches. All these facts are shared with the law enforcement.

The history indicates that at the end of a busy day of doing laundry and housework, mother took a shower, then decided to give the two year old a bath. She adjusted the water to the proper temperature, then plugged the drain, and put the child in as the water ran. The phone rang, and she went to answer it, but told the caller to call back later as she had a child in the tub. She estimates the call took her away for about 30 seconds. As she returned she heard the two year old screaming, and found him standing in the water with red, but not yet blistered burns.

Law enforcement officers went to the home, and ran the hot water for some time, to prime the pipes as they were in the history. They then put a ruler and a fast reading thermometer in the tub, and another fast reading thermometer under the tap. They started a stop watch and turned the tap on full hot. The water emerged at about 90 degrees, but the thermometer rose to 135 degrees within 20 seconds, and stabilized. Water in the tub rose slowly to eight inches depth, taking about five minutes to rise to that level. Initially the tub water was 75 degrees. Within a minute, it had risen to 115 degrees. By the time the tub was filled to eight inches, the water temperature was 125 degrees.

This scene investigation tells us several things. The tap water is too hot, and may cause full thickness burns within a few seconds when fully hot. On the other hand, the tub water, while painfully hot, would require a few minutes to cause full thickness burns. Additionally, filling to eight inches takes five minutes, not the thirty seconds reported by the mother.

In order to cause such a burn, without restraining the child for an unreasonable time, the mother would have had to run fully hot water into the tub initially, to warm the tub and prime the tap. Then she would have had to run the tap for five minutes to achieve an eight inch depth. If all this preparation resulted in tub water that was still 135 degrees, the temperature at the tap, the mother still would have had to restrain the two year old in the flexed abnormal position during a ten second immersion to produce the particular burn pattern.

D. Imaging and Laboratory Investigation

Several infectious differential diagnoses have been listed. If clinically indicated, cultures will support these diagnoses. Unusual conditions such as bullous pemphigus can be confirmed on skin biopsy, if clinically suspected. Otherwise, no routine labs are done to rule out alternative hypotheses.

While there is literature suggesting that burn patients are less likely to have evidence of other inflicted injuries, a reasonable search should be performed. Skeletal X-ray survey in the child under two is required. A severely burned older child will be on pain medications, and unable to reliably indicate other injuries, so they should also be investigated with skeletal X-ray survey. AST, ALT, amylase, lipase and urinalysis should be collected to evaluate for visceral injury. Visceral injury and burn injury have the same peak age of incidence. Screening imaging of the head is not required, but a

child with depressed consciousness should have a head CT.

E. Assessment and Diagnosis

A diagnosis of abusive inflicted burning may be made where the burn pattern is unmistakably abusive in nature. Clear immersion burns of the buttocks and lower extremities, with sharp high tide mark, and limited splashing should be regarded as abusive, barring a very unusual history. Where the child is neurologically handicapped and might be expected to remain in painfully hot water without alarming or moving, an exception may be made. Spill burns require more careful evaluation of the history. Full imprint contact burns are highly suspicious. When they occur repeatedly or the history fails to reasonably explain them, abuse should be diagnosed. Partial imprints will again require consideration of the history, and how it emerges.

Many burns that are not the clear result of abuse, have an element of supervisory neglect. Defining when lack of supervision is neglect, and when neglect rises to a reportable or criminal level is difficult. When a child suffers a significant injury, or was placed at risk for severe or fatal injury, by caretaker oversight, diagnosing child neglect and reporting this to CPS is reasonable.

F. Diagnosis and Treatment Plan

Mild burns may be treated topically in the outpatient setting. Severe burns require specialized treatment and will be referred away from the CHAMP physician. In this setting, the CHAMP physician will need to support the investigating team in requesting assistance of the treating facility, interpreting medical records, and coordinating the scene investigation. Most diagnostic issues in burning are rapidly resolved. Long term care, however, may be quite involved, prolonged, and taxing. Assuring that the family, or CPS system adheres to follow-up treatment is difficult, and may again raise issues of neglect. Victims of severe non-inflicted burns may also have significant emotional consequences. Assuring that mental health treatment occurs further contributes to the child's best outcome.

G. Conclusion

Minor burns are evaluated much like bruises and other cutaneous trauma. Major burns will likely place the CHAMP physician in the position of outside consultant. This is a difficult but valuable role. Simply assuring that a quality burn scene investigation is performed contributes in a great way, to the evaluation. Another role for the CHAMP physician is educational. Burns and burn scene investigation is a topic that may be presented to CPS and law enforcement before the next burn case is investigated. This will both cement the relationship between physician and system, and prepare the system for a good first response.

Chapter 7: Evaluating Skeletal Trauma

Reading:

Kleinman PK, Marks SC, Blackbourne B The metaphyseal lesion in abused infants: a radiologic-histopathologic study. AJR Am J Roentgenol. 1986; 146: 895-905

Barsness KA, Cha ES, Bensard DD, Calkins CM, Partrick DA, Karrer FM, Strain JD The positive predictive value of rib fractures as an indicator of nonaccidental trauma in children. J Trauma. 2003; 54: 1107-10

Clyde Piere M, Bertocci G,Vogeley E, Moreland MS. Evaluating long bone fractures in children: a biomechanical approach with illustrative cases. Child Abuse & Neglect. 2004; 28: 050-524

Clyde Pierce M, et Al. Femur fractures resulting from stair falls among children: and injury plausibility model. Pediatr. 2005; 115: 1712-1722

Merten DF, Radkowski MA, Leonidas JC. The abused child: a radiological reappraisal. *Radiology.* 1983;146c:377-381

Kemp AM, Butler A, Morris S, Mann M, Kemp KW, Rolfe K, Sibert JR, Maguire S. Which radiological investigations should be performed to identify fractures in suspected child abuse?Clin Radiol. 2006; 61: 723-36

Zimmerman S, Makoroff K, Care M, Thomas A, Shapiro R. Utility of follow-up skeletal surveys in suspected child physical abuse evaluations. Child Abuse Negl. 2005;29:1075-83

Kleinman PK, Nimkin K, Spevak MR, Rayder SM, Madansky DL, Shelton YA, Patterson MM. Follow-up skeletal surveys in suspected child abuse. AJR Am J Roentgenol. 1996; 167: 893-6

Day F, Clegg S, McPhillips M, Mok J. A retrospective case series of skeletal surveys in children with suspected non-accidental injury.J Clin Forensic Med. 2006;13: 55-9

Belfer RA, Klein BL, Orr L. Use of the skeletal survey in the evaluation of child maltreatment.Am J Emerg Med. 2001; 19 122-4

Ellerstein NS, Norris KJ. Value of radiologic skeletal survey in assessment of abused children. Pediatrics. 1984; 74: 1075-8

Jaudes PK. Comparison of radiography and radionuclide bone scanning in the detection of child abuse. *Pediatrics.* 1984;73:166-168

Skeletal trauma often reflects severe physical abuse. When discussing fractures, as with much of physical abuse, it is important to pay attention to a child's age and developmental ability. Fractures from the birth process have special significance that must not be missed. Fractures during early infancy, when children are non-ambulatory, are the most concerning for abuse. As the child develops size, motor abilities, and speed, the frequency of non-inflicted fracture increases and the difficulty of discriminating accident from abuse becomes more difficult.

An additional difficulty, is that the CHAMP physician may not care for skeletal trauma in their primary medical practice. Fractures are largely diagnosed by radiologists and treated by emergency departments and orthopedic surgeons. Other physician's experience with fracture may be limited. Much is to be learned, but the CHAMP physician can bring a unique thought process and skill set to the table, which adds greatly to the abilities of the other specialties. It is important not to lose sight of your value in this unfamiliar territory.

A. History:

The injury event history has particular importance when assessing fractures. Because of this we will re-iterate several points made earlier. It is important to determine whether the history provided is a report of a directly witnessed event, a report inferred from indirect evidence, or a second hand report of another person's observations. With this in mind, the actual observations, not the inferences, of the historian must be gathered. If no trauma is reported, a suitable period of time prior to presentation must be reviewed. Give the historian an opportunity to identify overlooked trauma, or to specifically deny that trauma has occurred. A general question about trauma should be used for this. Offering plausible histories to be rejected piecemeal is inappropriate. When a trauma event is reported, it must be reviewed in detail. The position and actions of the child, and other involved person's before the trauma event must be described. The trauma event should include body positions; contact with surfaces, objects and other persons; sounds heard; the child's response; how the child fell, and the final position of the child. At best, the CHAMP physician should have a movie like feel for what transpired during the event. For indirectly observed events, what was heard seen or known prior to the trauma event; any distant or indirect observations, such as sounds heard during the trauma event; and the next direct observation of the child, including emotional response, location, position, verbalizations, symptoms and signs; help create an impression of what might have happened.

The complete past medical and family history is taken. The family history must probe for evidence of brittle bone diseases. It is not enough to ask if someone in the family has brittle bones or osteogenesis imperfecta. The CHAMP physician should identify how many fractures each biological parent and sibling has had, and how those fractures were sustained. Dental conditions and hearing loss in the parents should be evaluated. Look at the parents' sclerae, and ask about unusually blue sclerae in their childhood. Evaluate their height relative to population norms and their family trend. Then ask about relatives

suffering unusually short stature, blue sclerae, multiple ill explained fractures, dental fragility, and early adult hearing loss.
Osteogenesis imperfecta is not the only condition causing fragile bones. Premature birth, particularly when accompanied by parenteral nutrition, steroid use, diuretic use, and bronchopulmonary dysplacia, may cause fragile bones. Over-reliance on human milk, when combined with dark skin, limited sun exposure, and lack of vitamin D supplementation can result in rickets. Renal disease, certain immunosuppressive drugs, chronic medical conditions, and prolonged immobility can each contribute to skeletal fragility. These possibilities must be probed in the medical history.

B. Physical Examination:

The physical examination is once again a complete evaluation, not problem focused. Bruising may be sought at the fracture site, but it is far from unusual to see no evidence of overlying cutaneous trauma. Of course other evidence of injury will be sought. Specific observations related to osteogenesis imperfecta are short stature, flat posterior skull with frontal bossing, blue sclerae, and bowed extremities. Unusual skin is also germane both for osteogenesis imperfecta, and for Ehlers Danlos syndrome.

Radiological evaluation of the skeleton is sure to follow, but direct examination, by observation and palpation will clarify if the child demonstrates pain or tenderness, whether swelling, erythema or deformity is apparent, and whether crepitance or other audible evidence of injury is apparent.

C. Imaging and Laboratory Investigation:

Every child under age two will need to be evaluated with a skeletal X-ray survey. Children under five may benefit from a skeletal X-ray survey, when the index injury is itself skeletal, though the return is less. A skeletal X-ray survey is a series of films specifically chosen, aligned and exposed to view all the bones of the body. Twenty one films are recommended in the initial series, as listed below.

AP and lateral skull
Lateral C-spine
AP, lateral and bilateral oblique ribs
Lateral LS-spine
AP abdomen and pelvis
AP humerus right and left
AP radius and ulna right and left
AP femur right and left
AP tibia and fibula right and left
Oblique hands right and left
AP feet right and left

In many institutions it may be necessary to order these films individually, as simply ordering a skeletal X-ray survey will result in a “babygram” with the whole child, or

large segments of the child, exposed on a single plate. A babygram is NOT adequate to rule out possible trauma.

In addition to identifying the presence, and nature of the index and other occult injuries, X-ray provides some evidence of the age of each injury. The absence of visible healing in ribs and long bones suggests that less than a week to ten days has transpired since injury. Beyond that, cues to fracture age exist, but need significant experience to interpret. In general, broad ranges, rather than specific dates should be expected. The presence of fractures in multiple states of healing indicates multiple events; a single episode of non-inlicted trauma is an unlikely cause.

Given the limited ability to precisely age a fracture, it is generally very difficult to pinpoint a narrow window of time. Thus, depending on who had access to the child during that period, the age of each fracture is unlikely to specifically identify an assailant.

Additional imaging is often necessary. Nuclear medicine bone scans have been recommended as more sensitive to rib fracture. Unfortunately this enhanced sensitivity comes with limited ability to detect skull fracture and difficulties in evaluating metaphyses of long bones. Combining a nuclear medicine scan with a skeletal X-ray survey will increase sensitivity, and is one way to evaluate a child more thoroughly when time is of the essence. If two weeks is available for evaluation, however, an alternative has some benefits. Repeating a limited skeletal X-ray survey in two weeks adds significantly to the sensitivity and specificity of the evaluation. The skull films may be eliminated, and sometimes the series can be limited to four views of the ribs, and single views of the shoulders, elbows, wrists, hips, knees and ankles, evaluating the metaphyses of the long bones. Any questionable areas from the first survey should be re-examined.

Routine laboratory tests are not generally recommended to evaluate skeletal fragility. Where renal, hepatic, or endocrine function, or nutritional sufficiency are questioned, they may be evaluated. BUN, creatinine, calcium, phosphorus, parathyroid hormone, 25 and 1-25 hydroxy vitamin D levels, may each contribute to the evaluation. The skeletal X-ray survey may also contribute to evaluating for fragile bones. Poor apparent mineral density, thin cortices, and the presence of excess wormian bones of the skull, may contribute to concerns. The absence of concerns on skeletal survey, however, does not eliminate the possibility of skeletal fragility. Unfortunately DEXA and other radiological bone mineral studies are not yet highly reliable in the evaluation of infants.

Where the only basis for abuse concerns is fracture under questionable circumstances, there is some new evidence to suggest that laboratory testing for osteogenesis imperfecta will detect some OI misdiagnosed as abuse, even when there is limited clinical suspicion. This is a new concept, and not universally practiced. It seems as if skin biopsy and phenotypic testing of collagen secreting cells is the best first test, though some opt for gene sequence testing since it may be performed on a blood sample. These tests are expensive, and take significant time, so last minute testing before a court appearance must be avoided. Finally, a negative test does not perfectly exclude OI, though it is able to detect about 90% of cases.

D. Assessment and Diagnosis:

Evaluating fractures requires specific knowledge of the epidemiology of fractures, a biomechanical understanding of how they occur, a consideration of the history, and of course knowledge of other injuries that may be present in the child. As with other abuse injuries, the crux of the matter involves evaluating whether the history reasonably explains the physical findings. The presence of multiple unexplained injuries in a child, for example, raises significant concern for child abuse. But even this relatively strong case has been challenged as an example of osteogenesis imperfecta, or more mysterious "temporary brittle bone disease." The most common, and most difficult case to evaluate is that of a child with a single fracture of a long bone, and a minor trauma history. If such a situation can be mastered, other circumstances will be easily overcome by the same methods.

Epidemiology, as we will use the term here, includes both statistical observations formulated from the observation of large populations, and individual observations that are instructive. An epidemiological consideration of a fracture may offer a probabilistic answer, rather than a firm conclusion. For instance, femur fractures in infants have been the subject of significant research. Frequencies of abuse have varied widely, from 30% to 80% but are all high. If the group is defined by independent ambulation, rather than age, it appears as close to 50% of femur fractures in non-walking children, are due to abuse. Knowing nothing else, if you are approached with a seven month old suffering femur fracture, you would then opine that there is a significant likelihood of abuse, approaching the preponderance of the evidence. A small case series of femur fractures sustained when non-ambulatory infants were playing too vigorously in exersaucers has been published. The fractures were buckle or impacted transverse fractures of the distal-posterio-medial metaphysis. Similar fractures have been described following short falls off of a bed, but this fracture has also occurred in cases of abuse. With this in mind, if the case before you now had an accompanying X-ray, showing this form of fracture, your assessment would have to change. You would need to reflect that while all femur fractures taken together have a strong association with abuse, this particular fracture has a history of occurring following relatively minor trauma, some of which might not appear traumatic at all to an adult observer. Let's say you now had the opportunity to take a history from the parents, and they absolutely denied any trauma. They insist that they put their baby to bed well on the prior day, and found the baby upset, and unable to bear weight the next morning. The absence of explanatory history, and development of symptoms in a protected environment again raises the question of abuse, because it suggests that the parents are hiding something. On the other hand, our experience with this fracture morphology indicates that what they are hiding may not be serious injury. Might they have taken a crying baby from an exersaucer and put him to bed in frustration. Might someone have dropped the baby and be afraid to admit it to the other parent or a system that could judge them. Or are they hiding a willful violent act that injured their baby? A well considered opinion would need to consider all possibilities.

Several fractures have been noted to be associated with abuse. As mentioned before, femur fracture has been frequently studied. In non-ambulatory children it had been found to be abusive about 50% of the time. Humeral fractures are also fairly well studied. Supracondylar fractures are a fairly common accidental injury in the broader age ranges these studies included, but in children under 18 months, non-supracondylar humeral fractures were significantly associated with abuse. All humeral fractures, taken together, are found to be abusive about one third of the time. A videotaped exception occurred when a three year old rolled her infant sibling from a prone position, with the arms in a forward prop, over to the infant's back. This motion resulted in a spiral fracture of the humeral mid shaft. Several studies of infant rib fractures have yielded a convergent result, 80% association with abuse. The remaining 20% sustained their fracture during a motor vehicle crash, when an adult fell while holding the infant, during an uncommon birthing injury, or due to an underlying bone disorder. The classic metaphyseal lesion (CML) is the proper name for a fracture of the metaphyseal-physeal junction giving the corner chip or bucket handle appearance. This is the radiological finding most suggestive of abuse. Despite this there are no epidemiological studies. There are a few published exceptions. Children have sustained similar appearing lesions during cephalic version for breech presentation, and during serial casting for club-foot deformity. One study reported similar lesions in children with osteogenesis imperfecta, but only when their disease was advanced and radiologically obvious. An important caveat is that a child can both have an underlying medical condition and be abused.

Fracture	Population	Abuse Likelihood	Published Exceptions
Femur	Non-ambulatory infants	50%	Exersaucer and short fall fracture of the distal metaphysis
Humerus (not supracondylar)	Children under 18 months	30%	Child rolled over from prone by someone
Rib	Infants under 12 months	80%	Motor vehicle crash Osteogenesis imperfecta Fall in the arms of a falling parent Birth fracture
Classic Metaphyseal Lesion	Infants under 12 months ? others ?	Near pathognomonic	Serial casting for club-foot External version for breech Radiologically apparent OI

Additional fractures that have been reported as associated with abuse have not been studied much but should be known. Sternal fractures, scapular fractures, and fractures of the spinous process of the vertebra are believed to be strong indicators of abuse. Fractures of the small bones of the hands and feet in infants, and fractures of the distal or medial clavicle, rather than the common mid-clavicular fracture, are felt to be concerning for abuse as well.

Biomechanics may be useful in assessing a given history, though this must be done with care and humility. Transverse and some oblique fractures absorb the most energy. Energy absorption increases as fractures go from simple plastic deformity, to greenstick, to complete, to displaced, to comminuted. As such, a completely displaced transverse fracture is a very high energy fracture, whereas an incomplete, non-displaced spiral fracture may occur with a lower energy event. This has been shown in the lab, and through clinical correlation. Clinically this means that "high energy" fractures call for a history where the child fell further, or was moving faster, prior to any impact. Unfortunately, there are no numerical energy thresholds that are clinically useful, so it remains speculative to determine which events possess enough energy to cause which fractures. Still, the general concept will help point out where the CHAMP physician should raise suspicion, and where caution is advised. Transverse and shallow oblique fractures occur from blows and bending, while long oblique and particularly spiral fractures indicate torsion or twisting of the bone. It is not always possible to identify the presence or absence of twisting or bending in a history, but apparently inconsistent mechanics will form a basis to increase suspicion. Impacted fractures, such as buckling, indicate forces directed axially up or down the bone. Again the possible presence of such forces must be identified in the given history and correlated with the clinical fracture.

While we are evaluating the history, some studies have looked at histories more in depth. The absence of a history of any trauma is always a concern for abuse, when a child is very young. As the child becomes more independent and mobile, historical absence begins to lose its specificity for abuse, though neglect remains as something to be considered. Some authors have looked at the completeness of a reported observed event. The child's initial condition, the nature of a fall, and their landing posture were requested. As historians were less able to provide all three components, the likelihood of abuse increased.

Differential diagnosis must be carefully considered in these cases.
1. The occurrence of brittle bones from any cause, but particularly from osteogenesis imperfecta, must be excluded. Until recently, it was recommended that a good clinical assessment, with an open mind, was enough to exclude osteogenesis imperfecta in a child abuse case. Recently this recommendation was revised. Some authors are recommending that when an abuse case rests exclusively on fracture following limited trauma, screening tests for OI will identify a very small number of cases in which OI is mistaken for child abuse. While rickets, prematurity, and chronic medical illnesses have not received as much scrutiny, clinical assessment, accompanied by a low threshold for progressing to laboratory assessment, remains the standard.

2. Another cause for confusion is radiological variants. Variations of the acromion process, pelvis, and metaphyses of the long bones have been mistaken for fractures. These concerns can be evaluated by comparing a repeat skeletal x-ray survey to acute films for evidence of healing. Perhaps the most common source of confusion is physiologic sub-periosteal new bone formation. This variant looks like a healing response to skeletal injury, though no fracture is seen. It is common in infants under six

months of age. It is usually symmetrical, but may be asymmetric. Pediatric radiologists are very familiar with this entity, though general radiologists may not be.

A high energy fracture or a fracture with high prevalence of abuse, such as rib or CML, and an absent or clearly inconsistent history is adequate basis to diagnose abuse, so long as additional non-skeletal injuries are present, or OI had been clinically excluded. When a fracture is a lower energy type and less epidemiologically associated with abuse, trauma is reported, but its consistency is uncertain, abuse may be suspected but not ultimately diagnosed. Still the CHAMP physician may be able to lay out the likelihood of abuse, and describe what abusive or accidental acts would be expected.

E. Diagnostic and Treatment Plan:

We have talked about making a diagnosis of abuse at an evaluation. Often, however, we must offer an opinion on the likelihood of abuse, while further evaluation is still pending. This is a particularly common situation in suspicious fractures. If the history is inconsistent, the epidemiology suggests likely abuse, and there are no clinical signs of osteogenesis imperfecta, the CHAMP physician will likely make a preliminary diagnosis of abuse, though a genetics consult or skin biopsy study is pending. This should be explained clearly to consulting agencies. All medical diagnoses are subject to revision. In two weeks a repeat skeletal survey may remove all doubt about abuse, or identify a suspected fracture as a normal variant. An osteogenesis imperfecta evaluation may take weeks to arrange, and more than 6 months to return. When these tests are complete, the diagnosis may change, but until that time the child should be treated as if abuse is the case, not as if the answer is unknown. In many instances where abuse is probable albeit not definite, the need to protect the child should be seriously considered. If future evidence changes the initial evaluation findings, the intervention should be modified.

Treatment of the fracture will require working with an orthopedic surgeon. Cultivating this relationship may be particularly important. Orthopedists are quite often dismissive of abuse concerns. They forget their referral bias, and see injuries as common, when in fact they are not. Because of their great experience with skeletal injury, their opinion may seem to have greater weight than that of the CHAMP physician. Working in partnership is the best resolution of this situation. Competing for influence over the child protection system may be necessary in some cases, but is a poor substitute for true partnership.

F. Conclusion:

The consideration of fractures is often complex. As injuries occur within the body, they become less intuitively obvious to both physicians and the protection systems that we must enlist in treating our patients. This chapter has only scratched the surface. Further and continued study of the literature, and personal experience will reward the CHAMP physician with a greater sense of certainty.

Chapter 8: Evaluating Head and Other Internal Injuries

Reading:

Minns RA. Shaken baby syndrome: theoretical and evidential controversies. J Royal Coll Physicians. 2005; 35: 5-15

Kemp AM. Investigating subdural haemorrhage in infants. Arch Dis Child. 2002; 86: 98-102

Duhaime, A.C., et al., Nonaccidental head injury in infants--the "shaken-baby syndrome". N Engl J Med, 1998: 338; 1822-1829

Feldman KW, et Al. The cause of infant and toddler subdural hemorrhage: a prospective study. Pediatr. 2001; 108: 636-646

Duhaime AC, et Al. Head injury in very young children: mechanisms, injury types, and ophthalmologic findings in 100 hospitalized patients younger than 2 years of age. Pediatr. 1992; 90: 179-185

Hettler J, Greenes DS. Can the initial history predict whether a child with a head injury has been abused. Pediatr; 2003: 111: 602-607

Jenny, C., et al., Analysis of missed cases of abusive head trauma. JAMA, 1999: 281; 621-626

Shugerman RP, Paez A, Grossman DC, Feldman KW & Grady MS. Epidural hemorrhage: Is it abuse? Pediatrics 1996;97:664-668

Herr S, Fallat M. Abusive Abdominal and Thoracic Trauma. Clin Pediatr EmergMed, 2006; **7**: 149-152.

Ledbetter DJ, Hatch EI, Feldman KW, Fligner CL & Tapper D. Diagnostic & Surgical Implications of Child Abuse. Arch Surg. 1988; 123: 1101-1105

Rubin DM, Christian CW, Bilaniuk LT, Zazyczny KA, Durbin DR. Occult head injury in high-risk abused children. Pediatr. 2003; 111: 1382-1386

Laskey AL, Holsti M, Runyan DK, Socolar RRS. Occult head trauma in young suspected victims of physical abuse. J Pediatr. 2004; 144: 719-722

Coant, PN, et Al. Markers for occult liver injury in cases of physical abuse in children. Pediatrics, 1992; 89: 274-278

It is not anticipated that the CHAMP physician will be consulting much on patients with head and other internal injuries. Though these cases are life threatening, and often controversial, they are infrequent. Many times these children are ill enough to be shipped far from their home, and far from the CHAMP provider. It will take significant time for the CHAMP physician to gain enough experience to be the primary consultant on such a case. Still, there is an important role for the CHAMP physician when one of these children is admitted to the regional trauma center. Investigating agencies will be co-located with the CHAMP physician, sometimes far from the child. Communication with the treating facility can be significantly improved if the CHAMP physician is available to interpret reports, make phone calls, and coordinate consultation with other child abuse specialists. With that in mind, this chapter will depart from the organizational scheme of the other chapters. Let's discuss some issues that impact the assessment of cases with injury to the brain and other internal organs.

1. Imaging Studies:

We have already discussed imaging of the skeletal system. Virtually all children with head and visceral injuries will require a skeletal X-ray survey. The average age of these children is quite young, the nature of their injuries indicates severe trauma, and they often suffer from pain, shock or neurological compromise that make them a poor reporter of their own injuries. Additional study by repeat skeletal X-ray survey, may be overlooked, particularly if a child is discharged prior to two weeks following injury. The CHAMP physician will need to explain the reason for repeat imaging, and encourage parents, the PMD as well as CPS and perhaps law enforcement to obtain the follow up studies

Head injured children virtually always receive an initial CT scan of the head. This is the quickest way to detect injury and bleeding, and it allows ready access to unstable patients in the crucial early hours of care. CT scan is quite sensitive for acute subdural bleeding, the commonest finding in inflicted head trauma. It may not be able to distinguish between very small acute epidural, subdural and subarachnoid hemorrhages. Similarly, chronic subdural hemorrhages and expansion of the subarachnoid space may not be well distinguished. A recently realized shortcoming is that distinguishing new collections, from old collections, and collections of mixed age, is fraught with more difficulty than once imagined. A radiologist's report that interprets bright collections as acute subdural hemorrhage, isodense collections as ten to fourteen days old, and dark collections as 21 or more days old, does not adequately reflect current data on the appearance of SDH over time. Mixed density collections may be of a single generation in both the acute and chronic phases.

MRI scanning has been recommended for ALL children with suspected inflicted head trauma by the Society of Pediatric Radiology and by the American Academy of Pediatrics. Despite this, it is sometimes difficult to get an MRI because physicians caring for the child do not find it clinically necessary, or, because the patient is unstable. MRI will better distinguish subdural and subarachnoid collections, is more sensitive to brain parenchymal injury, helps to evaluate vascular anatomy and anomalies, and provides additional data to consider when evaluating the age of blood collections. Just as CT

scanning is going through a reappraisal as an instrument to date intracranial blood collections, MRI is going through the same process. The concordance of MRI and CT data, interpreted by an up-to-date pediatric radiologist or neuroradiologist is valuable.

Screening for abusive head injury has been recommended, when children present with other forms of child abuse. Two articles have looked at the return on CT scanning of asymptomatic patients. The return has been reasonable when studies are confined to children under six months with other convincing signs of inflicted injury, and children between six and twelve months with head or facial bruising, rib fracture, or classic metaphyseal lesions. .

Visceral injury is almost always assessed by CT scanning. Ultrasound, plain radiography, and contrast radiography may have their place, which should be determined by a radiologist. Imaging is usually guided by clinical appearance. The chance of a positive scan is higher when there are externally apparent abdominal injuries, or the history includes focused compressing trauma to the abdomen. Unfortunately, the majority of children with visceral injury have no externally apparent injuries, and abuse cases often present without an accurate history. When child abuse is suspected, the index of suspicion must be high for internal injuries. There is, however, no current recommendation for screening CT scan of the body. Screening for liver injury with transaminases is supported by one clinical study, and there is some support for screening with a serum amylase and a urinalysis for pancreatic and kidney injury.

2. Laboratory Testing

All internal bleeding should prompt a bleeding assessment. While CBC, PT, and PTT may suffice for a bruised child with a negative family history, a more extensive evaluation is called for here. Thrombin time, fibrinogen, fibrin degradation products, D-dimers, factor VIII, IX, and XIII levels, von-Willebrand's panel, and platelet function studies have all been recommended. The role of PIVKA for detecting vitamin K deficiency has been debated. Not only may coagulopathy cause intracranial bleeding, but brain injury may cause coagulopathy. Follow up assessment with a hematologist may help clarify this situations, though this may take some time. When head injury is accompanied by stroke, or venous sinus thrombosis, thrombophilia evaluation may be recommended. Protein C, protein S, antithrombin, factor V Leiden, Prothrombin mutation, anti-phospholipid antibodies, MTHFR mutation, and others are sometimes recommended. Again, a hematologist may best direct such an assessment. The CHAMP physician may need to be the person who suggests hematological evaluation of the family, or in the follow up period.

Genetic diseases impact on internal injuries as well. Glutaric aciduria type 1 is rare, but may present as subdural hemorrhages with limited retinal hemorrhage. These children typically have large heads, and excess sub-arachnoid fluid. In particular, they suffer from front-temporal atrophy, which gives a particular CT or MRI appearance. A family history of mental retardation, cerebral palsy or movement disorder should prompt the search for this or other metabolic disorders. Visceral injuries may be the consequence of

Ehlers Danlos syndrome. Type four in the old nosology, or vascular type in the new system, may suffer large blood vessel or hollow viscus compromise following minor or inapparent trauma, creating confusion with abuse. Osteogenesis imperfecta has been reported to present with limited retinal hemorrhages and with subdural hematoma, in rare instances. The additional finding of fractures would be seen as confirming the abuse diagnosis, but actually also supports the diagnosis of osteogenesis imperfecta. The CHAMP physician may need to explain these conditions to investigators, and suggest a genetics assessment in the proper setting.

3. "Shaken Baby Syndrome" versus inflicted head trauma

While the CHAMP faculty believe in the existence of the Shaken Baby Syndrome, and the injurious effects of violent shaking, a liberal and injudicious use of this concept will result in misunderstanding and courtroom controversy. The scientific underpinning of the shaken baby hypothesis have been attacked, and biomechanical arguments on both sides of the deliberation are both compelling, and incomplete. Physicians have diagnosed SBS in the face of scalp contusions and skull fractures, clear evidence of head impact. Police investigators have over focused on shaking, and taken reports of gentle shaking to revive as a firm confession. The CHAMP physician must help investigators understand that shaking does not explain all head injuries, that subdural hematoma may result from other causes besides shaking, that some, but not all retinal hemorrhages strongly suggest shaking, and that injurious shaking is obviously violent and will not be mistaken for a normal or safe act. This education should take place before a case comes up, but will need to be re-stressed when an investigation is under way. In general we recommend that you use the term inflicted head trauma, and avoid using the term "shaken baby syndrome" while not rejecting the concept.

4. Delayed Care Seeking

Delayed care seeking is in the literature as a sign of child abuse. It appears in several research articles on visceral injuries, and many reviews. This is a good example where prior thinking was simplistic and has not borne the test of time and experience. There are times when serious complications from obviously inappropriate delay create the strong impression of abuse. In general, however, delay in care seeking is not a strong indicator of abusive etiology. It is not uncommon for a parent to first think the problem is minor and likely to improve. Often it does. Other times, it may worsen (eg a burn that becomes infected) and the need for professional care is apparent. The "delay" in seeking such care is understandable and reasonable.

There are many examples where the condition may deteriorate over time. Intra-abdominal injuries, in particular, have been found to worsen after a period of time. Sub-capsular hepatic hemorrhages may burst resulting in delayed onset of shock. Contused or ischemic bowel may rupture, resulting in delayed onset of peritonitis. While most of these children are symptomatic from the time of injury, prior to their delayed deterioration, rare cases of relatively normal behavior and even food consumption, prior to decay, have been reported. Similarly, serious head injury usually results in immediate

onset of neurological symptoms. Delayed deterioration is found in a few percent of severe head injury, but a larger proportion of mild head injury. Hyponatremia, seizure, and expanding intracranial mass are the classic causes of delayed deterioration. The CHAMP physician should make sure that investigators know of and explore these possibilities. Most investigators will presume that the child was with the abuser when they suddenly deteriorated. This is usually a correct presumption, but the possibility of exceptions should be explored.

5. Conclusion

This short sampling of the complexity of abusive internal injuries hopes to serve two purposes. First, we hope that CHAMP physicians will contact faculty to support them in all cases of internal injury. Second, the CHAMP physician will have the long term relationship with the local investigating agencies. The CHAMP physician will be in the best position to educate these investigators before hand, and to support them in their investigation, when areas of difficulty, complexity and controversy arise.

Elements of a Child Abuse History

The default option is a comprehensive assessment. Truncating the data base may be necessary, such as when no adult informant is available, or permissible, such as when a birth history has no relevance to sexual abuse injuries. If the full extent of injuries has not be completely assessed, such as when skeletal surveys and intracranial imaging is pending, it is hard to know what information is necessary.

A. History of Present Concern

1. Child's history
   taken separately from adults in a forensically sensitive manner
2. Adult informant's history

taken from each observer separately
how was abuse concern arrived at
what was actually seen
what other data was gathered and how

B. Past Medical History

1. Birth history (gestation, delivery type, Apgars, complications)
2. Hospitalizations
3. Surgery
4. Chronic and recurrent illnesses
5. Significant physical traumas
6. Chronic and current medications
   (prescription, non-prescription, herbals, nutritionals)
7. Medication and latex allergies
8. Recent and current acute illnesses
9. Dietary history
10. Review of systems

C. **Behavioral and Developmental History**

1. Developmental milestones
2. Temperament of child
2. Current developmental abilities
3. Toilet training history
4. Sleep history
5. School performance
6. Behavioral concerns
7. Behavior changes
8. Sexual behavior
9. From child, screening questions for depression, anxiety, suicidality PTSD
10. From child, history of risk taking (sex, drugs, alcohol)

D. Social History

1. Residents of all occupied households

2. Exposure to domestic violence
3. Exposure to adult sexuality
4. Parenting and disciplinary practices
5. Abuse history of involved adults

E. Family Medical History (as appropriate)

1. Coagulopathy
2. Osteogenesis imperfecta
3. Sexually transmitted infections
4. Others as appropriate

Protocol for Forensically Sensitive History from a Child

Establish rapport:

Talk about school, television, play or recent activities. Ask open-ended questions that require the child to describe things in a sustained narrative. Then ask them to tell you more, what happened next, etc. get them used to talking

Introduce your role:

Tell the child that you are their physician today, and need to talk to them so that you can take care of them. Tell them you need to ask some hard questions, which might be personal or embarrassing, but you need the information to take care of them. Ask them to help you by answering the questions truthfully. Some researchers feel that eliciting a promise to tell the truth is helpful. Do not, however, test the child's ability to determine truth from lie.

Attempt to elicit a narrative of the abuse:

The cleanest history occurs when you provide no information. You man begin by asking, "what happened to you so that you need to see the doctor today", or similar question.

Many children will answer "I don't know." You may set the stage, providing progressively more background information, until they respond.

"Has something happened to your body that was a problem?"

Remind them of antecedent events. "did you tell your mommy something that made her want you to see the doctor" etc.

Elaborate on your role. "I'm a special doctor, for when a big person, or kid, touches or hurts another kid. Has something like that happened to you?"

Situations will dictate whether you provide more information, or ask more direct questions. Never ask a question that might be construed to suggest a correct or preferred answer.

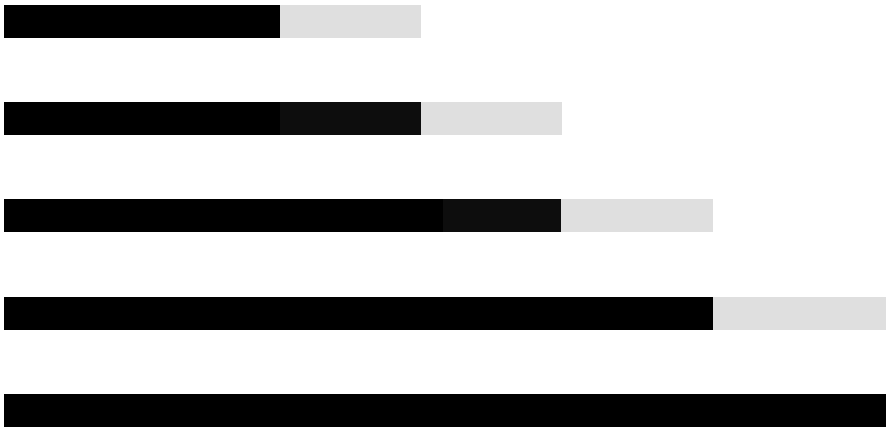
If a child begins a narrative, ask them to continue it. "Please tell me all about that." "Tell me everything about the last time that happened."

A child may need help structuring the narrative, "tell me what happened first", "what happened next", what happened before that."

Who, what and where questions can help get more information. When questions are hard for children, up to age ten or so. Why questions are often difficult at all ages. If asked, they must be prefaced so as to avoid suggesting that the child is culpable.

Guidelines for Age-Appropriate Interview Questions

Age of Child	Who	What	Where	When	# of times	Circumstance
3						
4-6						
7-8						
9-10						
11-12						



Adapted from: Walker-Perry, N. & Saywitz, K.

Special questions:

For ejaculation, “did anything get on you?” “did anything happen before he stopped?”

For threats, “did he want you to tell? How do you know?”

For pain and bleeding, “how did that feel? did it cause any problems for your body?”

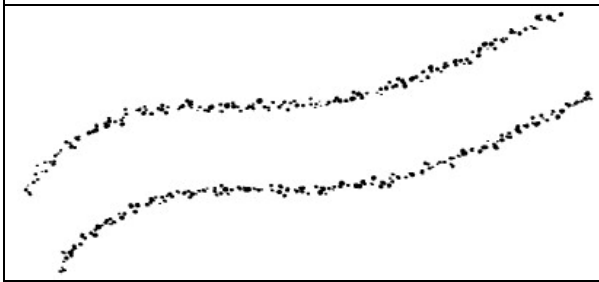
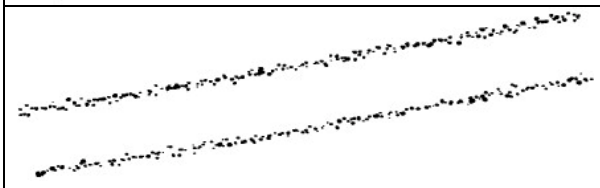
For dysuria, pain on defecation, “did you have problems with your body later? what made the problems come back? What was it like when you peed or pooped”

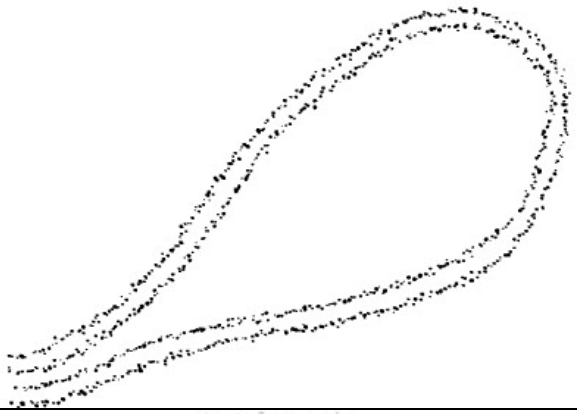
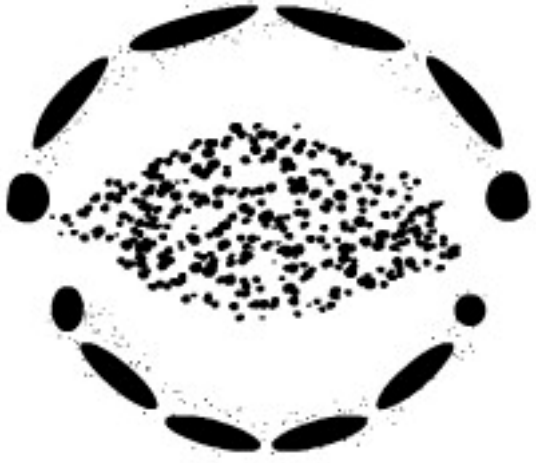
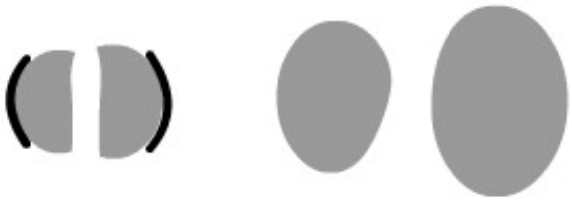
For disrobing, “where were your clothes?” “did he touch you on your clothes or the skin? how did he get to the skin? ”

Elements of a Child Abuse Physical Examination
(with notes of special attention)

A. Growth Parameters
B. General appearance and demeanor
C. HEENT
    retinal hemorrhages
    blue sclerae
    petechiae of pinnae
    swelling, or bruising or petechiae of scalp
    broken hairs, alopecia
    torn frenulae
    contused oral mucosa
    pharyngeal injury
    dental condition (carries, dentinogenesis imperfecta)
D. Neck
E. Chest / Lungs
    rib masses, crepitance
F. Heart
G. Abdomen
H. Extremities
    tenderness, swelling, deformity, guarding
    joint hypermobility
I. Cutaneous
    bruises
    scars
    pigmentary marks
    loose distensible skin
    papyraceous scars
J. Genitals
    structure by structure assessment for injury
    description of anatomy
K. Anus
    assessment for injury
    tone and dilation
L. Mental Status
N. Neurological and developmental status

PATTERNED BRUISES

	Slap marks are a fairly characteristic and recognizable form of bruising. Occasionally a full imprint of the hand may be seen. More typically a series of diverging rays, making a fan shape, will be seen. At first, the rays are composed of lines of confluent pettechia. With time, underlying ecchymosis may be seen, and the petechiae will become less discreet, making a more solid line. Petechia form at the edges of contact, outlining the hand, while deeper ecchymoses may form under prominences of the hand.
	Strap marks are a form of "railroad track" or "tram track" mark. Lines of petechiae form at the edges of contact. Because the strap is flexiple, it will wrap around body contours, and form a curved mark. The edge or tip of the strap may cut or abrade the skin.
	A board mark resembles a strap, but is straighter, and does not conform to body contours. Dips in the body may be skipped producing a break in the continuity of the mark.

	Loop marks are highly characteristic of abusive injury. A narrow spaced “tram track” or “railroad track” mark doubles over on itself forming a loop. Typically, this mark is the result of beating with a doubled over loop of extension cord. Sometimes a doubled over belt, striking on edge, will make this mark. It is common for the tip of the loop to cut, tear or abrade the skin.
	Bite marks require excellent documentation. The shape of a bite may allow a forensic odontologist to identify the biter. Excellent pictures, with a size standard in two axes, are critical. Swabs of a fresh bite may collect DNA that can be used to identify the biter as well. As a crude measure, childrens bites have less than 3cm between the upper canines, and adult bites have greater than 3cm between the upper canines. Adult dentition to the canines occurs at about 12-years-old.
	Pinch marks may be very distinct, or somewhat non-specific. Two, adjacent, oval bruises, the size of a knuckle or finger tip, may represent a pinch, or chance opposition. Finger nail marks outlining a clam shell arrangement of bruising is much more specific for pinching.
	Grip marks are comprised of oval bruises, of the size, and in the distribution of finger tips. Care must be taken to be sure other factors do not account for this distribution. For instance, if a slender child’s chest is injured on a hard edge, multiple oval bruises may develop over the rib prominences, while the intercostal space is un-injured. This has produced marks that resemble gripping.

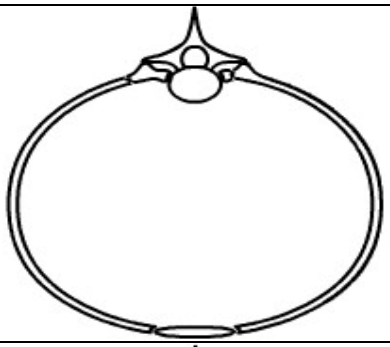
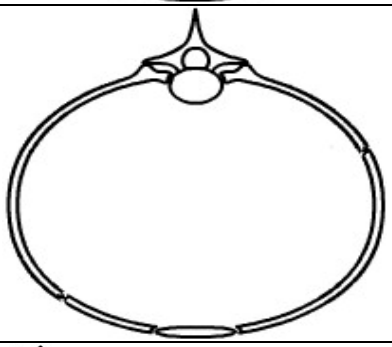
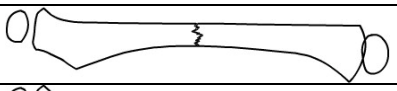
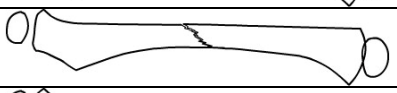
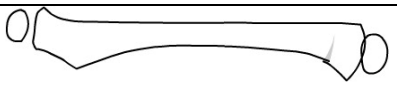
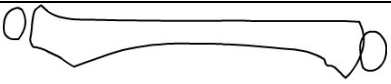
Ancillary Studies in Physical Abuse

Indicator	Standard
Child under age two with possible physical abuse that is not excluded on history and physical	Skeletal X-ray Survey
Child two to five-years-old AND Serious internal injury OR fracture as the index injury due to suspected physical abuse	Skeletal X-ray Survey
Continued suspicion of abuse at two weeks post presentation	Repeat Skeletal X-ray Survey OR Nuclear bone-scan in addition to initial X-ray survey
Child under six-months-old OR 6-12-months-old AND head or face injury, rib fx, mult fx, or CML	Head CT or MRI
Child under six-months-old OR 6-12-months-old AND head or face injury, rib fx, mult fx, or CML	Ophthalmology exam
Bruising or internal bleeding from suspected abuse	CBC, Platelets, PT, INR, PTT, vWD panel
Infant with possible and toddler with probable physical abuse evaluated less than 48 hours post trauma	ALT, AST, *There is limited evidence strongly supporting this form of screening*
Infant with possible and toddler with probable physical abuse evaluated less than 48 hours post trauma	Amylase, Lipase, Urinalysis *This form of screening has less evidence, but seems prudent*
Extensive soft tissue injury AND Evaluated less than 24 hours post trauma	Urinalysis, CPK *This looks for a rare complication of myoglobinuria. There is no research behind this recommendation*
Fracture is only indicator of abuse	Genetics consult or OI lab test
Fracture is only indicator of abuse	Ca, P, Alk Phos, PTH, 25-OH and 1,25-OH Vitamin D Urinalysis
Elevated abdominal organ enzymes ≥ two times normal	Abdominal CT scan

Indications for Sexually Transmitted Infection Testing

Postpubertal child reporting contact sexual abuse or other sexual activity
Pre-pubertal child with history or signs of insertive sexual abuse
Child with signs or symptoms of an STI
Perpetrator with suspected STI
Perpetrator with high risk for STI
- Men who have sex with men
- IV Drug abusers
- Professional sex workers
- Men who frequent prostitutes

Family member with STI
Other victim with STI
High community incidence of STI
Family or patient request for testing

Fracture	Illutration	Biomechanics	Notes
Rib, Posterior		Squeezing with back unsopported	Rib fractures in infancy are from abuse 80% of the time. Accidental rib fx result from motor vehicle crashes, adults falling onto children, conditions causing bone fragility, and occasionally the birth process.
Rib, Lateral or Anterior		Squeezing or direct impact	
Classic Metaphyseal Lesion		Shearing across bone end	The strongest radiological sign of abuse. A rare birth or accidental injury, occurs in advanced OI, and during casting for club-foot
Transverse		Bend or Blow	These fractures absorb the most energy, and require the greatest force.
Shallow Oblique		Bend or Blow	
Oblique		Bend plus torsion	Often confused with a spiral. Probably requires greater energy and force.
Spiral		Torsion	Spirals absorb limited energy and may not require great force. Toddler's fracture of the tibia, is a well known spiral.
Impacted		Angulation with axial load	Impacted Fx of the distal posterior femur is know to occur from simple bed falls. Principally occurs at the dia-metaphyseal junction
Buckle		Angulation with axial load	Differentiate from impacted Fx by no break in the cortex. Otherwise similar
Torus		Axial load	Term is often used more broadly. True torus requires buckling 360^{o} around the bone.

Films in a Skeletal X-ray Survey

AP and lateral skull
Lateral C-spine
AP, lateral and bilateral oblique ribs
Lateral LS-spine
AP abdomen and pelvis
AP humerus right and left
AP radius and ulna right and left
AP femur right and left
AP tibia and fibula right and left
Oblique hands right and left
AP feet right and left

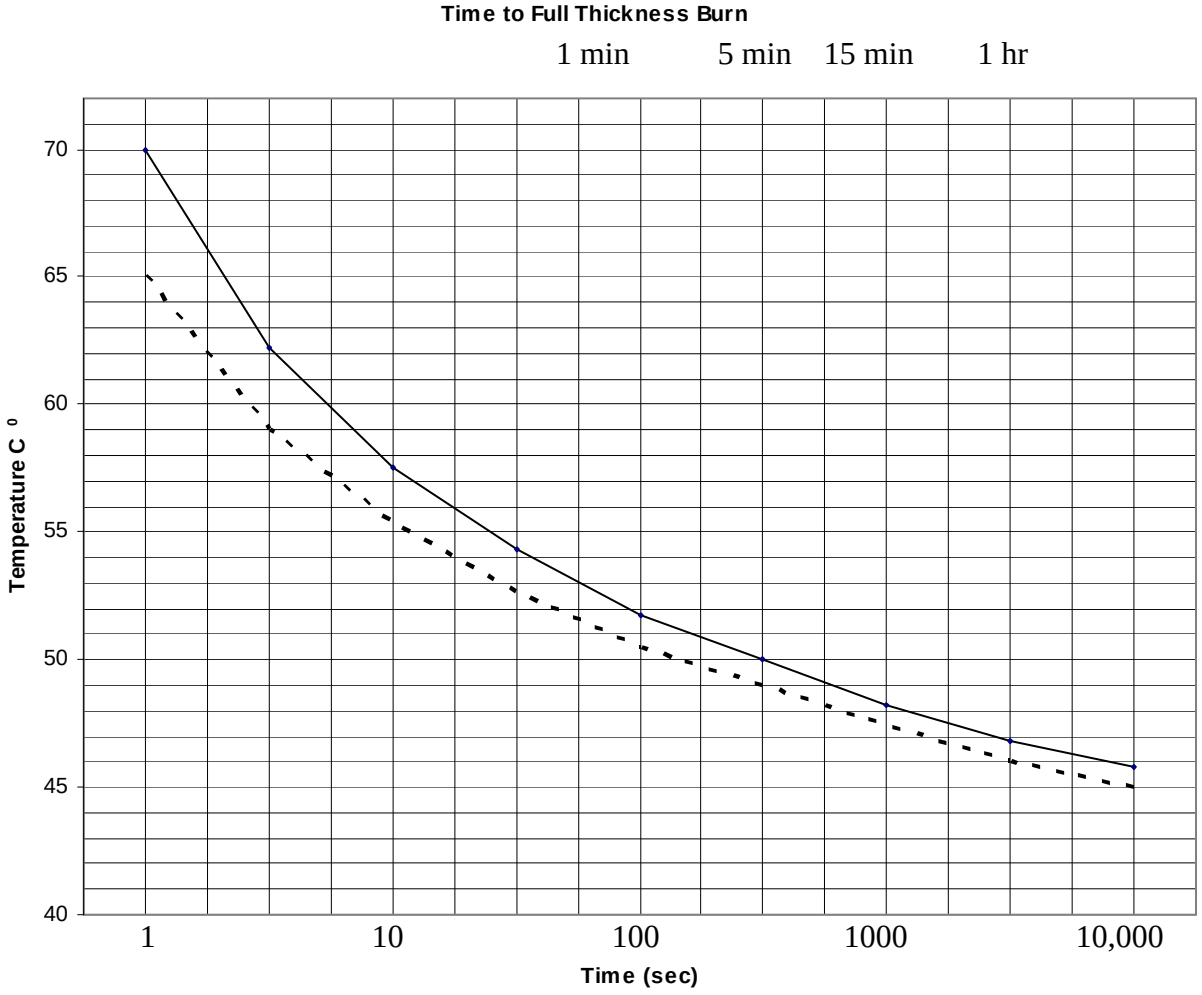
Each film must be appropriately aligned and exposed for the focal region. Combining humerus with radius and ulna, or femur with tibia and fibula will decrease sensitivity to metaphyseal injury

FRACTURES (Suspicious for abuse given context)

HIGH SPECIFICITY FOR ABUSE	MODERATE SPECIFICITY FOR ABUSE	LOW SPECIFICITY FOR ABUSE
Classic metaphyseal lesions (CML)	Multiple fractures, especially bilateral	Subperiosteal new bone
Rib fractures	Fractures of different ages	Clavicle fractures
Scapula fracture	Epiphyseal separation	Long bone shaft
Spinous process	Vertebral body	Linear skull fracture
Sternum fracture	Finger, toe fractures	
	Complex skull fracture	

Distinguishing Spill/Splash Burns from Immersion Burns

SPILL / SPLASH BURN	IMMERSION BURN
Varying depth of burn Deeper burns in area of first contact	Uniform depth burn
May see inverted triangle shape	Stocking or glove distribution Buttocks, lower back & perineum with sparir of flexor creases
Multiple areas of burn	Unvaried appearance
Indistinct borders	Distinct borders with sharply defined water lines
Splash marks	No splash marks
May be inflicted or non-inflicted	Usually inflicted



Important differential diagnoses of child physical abuse

Condition	Clinical Clues	Work-Up
Hemophilias	Family history "hemophilia" "bleeding disease" bleeding or oozing post surgery or dental procedure long, heavy menses hemarthralgia Child's history umbilical bleeding circumcision bleeding "easy bruising" bleeding gums from dental hygiene Exam many or more severe bruising in common areas (shins, forehead, forearms)	For cutaneous bruising PT, INR, PTT Von Willebrand's Panel For serious internal bleeding PT, INR, PTT Thrombin Time Fibrinogen Factor XIII If coagulopathy detected Factor VIII, IX Fibrin degradation products PIVKA Hematology Consult
Other Coagulopathy	Preceding viral illness Aspirin or NSAID use	Platelet aggregation studies PFA-100
Osteogenesis Imperfecta	Family History "brittle bone disease" ask for a parental history fracture by fracture dental fragility, implants, dentures early hearing loss blue sclerae in infancy atypical short stature for family Child's history birth fractures fracture by fracture history easy bruising infant head deformity blue sclerae in infancy short stature dental abnormality Exam blue sclerae head shape dental condition bowed extremities short stature	Skeletal X-ray survey demineralized bones thin cortices bowed long bones beaded ribs wormian bones of the skull Lab tests synthesized collagen digest electropheresis from skin biopsy sample. gene sequencing

Other Bone Fragility	Rickets dietary history of child vitamin supplementation Osteopenia of prematurity premature birth TPN steroids furosemide use bonchopulmonary dysplacia Renal disease family history of renal disease kidney stones nephrotoxic drugs	If suspicious P, Ca, PTH, 25 OH vitamin D, 1-25 OH vitamin D Urinalysis for pH Urine Ca, P Nephrology or Endocrinology consult

Child Abuse Diagnostic Assessment

Guidelines for making a final diagnosis of child maltreatment. Evidence not meeting these requirements may still support significant concern for abuse.

Physical Abuse

ICD-IX 995.54 child physical abuse
ICD-IX 995.55 shaken baby syndrome

Injuries are inadequately explained by given history
AND
Underlying fragility or medical conditions clinically excluded
AND
[Injuries indicate a mechanism that must be inflicted
OR
Injuries reflect multiple injury times, events or mechanisms]

Sexual Abuse

ICD-IX 995.53 child sexual abuse

Child makes clear detailed disclosure
AND
[Circumstantial observations support disclosure details
OR
Physical exam demonstrates consistent genital injury
OR
Sexually transmitted infection
OR
pregnancy]

[Sexually transmitted infection
OR
Penetrating sexual injury]
AND
No innocent historical explanation
AND
Pre-pubertal child