CHAMP Practice Recommendations

Skeletal Survey

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A skeletal survey is recommended for infants and children when trauma is suspected and when injuries may not be evident clinically. Children who have been physically injured due to non-accidental trauma may have overt signs and/or symptoms of fractures as well as other injuries. Some children who are suspected of being physically or sexually abused or maltreated may have occult injuries such as rib fractures. Skeletal surveys are also performed to assess for skeletal dysplasias, certain neoplastic conditions, and other disorders. ***Young children are most at risk for missed abuse. Skeletal surveys are recommended for all children under the age of two years when abuse is suspected.***

These recommendations were developed using American College of Radiology and American Academy of Pediatrics guidelines and other recent literature. They are intended to guide the medical provider in ordering appropriate radiographic studies to better identify injuries and assist with the determination of the age of fractures.[1,2] Note that negative radiographic studies can occur in situations of child abuse and that occult fractures can be missed despite the use of appropriate tests and techniques of study.

The literature supports the use of skeletal surveys in twin siblings of abused infants and toddlers up to age two. Other siblings should be evaluated clinically and then studied with a skeletal survey or other radiographic tests on a case by case basis. ***It is recommended that siblings under the age of one year who live in the same home as the index child abuse case(s) be examined by a pediatrician or pediatric provider and studied with a complete skeletal survey.***

The request for the skeletal survey examination must originate with the examining medical provider. It should include sufficient clinical information to demonstrate the medical necessity of the examination.

Bone scintography is also often utilized for detection of occult injury or fractures in suspected non-accidental trauma. For a complete evaluation for injuries of the suspected abused child, a bone scan (Tc-99m radionuclide bone scan) will complement the skeletal survey. The estimated radiation dose for a 5 year old who receives this test is 6.2mSv. This is a greater exposure than multiple films on a skeletal survey, for example 0.02mSv for two views of the chest.[5]

Infants who are studied with bone scan alone and no skeletal survey are at risk for missed skull fractures and classic metaphyseal and epiphyseal fractures. Infants where only a skeletal survey is performed, with no bone scan, are at risk for missed rib fractures, periosteal injury, subtle shaft fractures and rare fractures of the pelvis or foot. In addition, each of these studies can potentially result in false positives that may need case by case reassessment with further radiographic examinations.[6]

Per ACR guidelines, skeletal surveys should include the following films:

Thorax	Routine AP and lateral to include ribs, thoracic and upper lumbar spine
	Oblique views of the ribs *
Long bones of arms and legs (humeri, forearms, femurs and lower legs)	Routine AP views
	Additional views if needed: coned views of joints to look for metaphyseal injuries in greater detail
Hands and Feet	PA hands
	AP or PA feet
Abdomen/lumbosacral spine, pelvis	Pelvis AP to include mid-lumbar spine
	Lumbosacral spine lateral
Cervical spine	Lateral and AP
Skull	AP and lateral
	Additional views if needed: oblique or Townes recommended if occipital injury is suspected.

* In studies evaluating abused children, it has been shown that rib fractures are frequently not clearly visible on the initial skeletal surveys and these oblique films may assist with identification.[3] The British Society of Paediatric Radiology currently recommends rib oblique films.[4]

Recommended studies

Newborn to 2 years of age:

- A skeletal survey is recommended as a first line investigation, including oblique views of the ribs if rib fractures are suspected.
- If a bone scan is performed as a first line investigation, skull radiographs should be included and coned views of the metaphyses considered.
- Confirmatory radiographs must be taken of abnormal areas on a bone scan.
- If possible, both a skeletal survey and a bone scan should be obtained for early identification of injuries.
- ***A repeat skeletal survey 10-14 days after the first investigation is recommended, even if both a bone scan and a skeletal survey are obtained. Skull films do not need to be repeated.***

Over 2 years of age:

- Children who are immobilized or disabled should be studied according to the newborn to 2 years of age category.
- For children between 2 and 5 years of age, the need for a skeletal survey should be determined on a case by case basis and based on specific clinical indicators of abuse and suspected mechanism of trauma.
- Children older than 5 years of age generally do not benefit from the skeletal survey study.

References

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3. The British Society of Paediatric Radiology. Standard for skeletal surveys in suspected non-accidental injury (NAI) in children. http://www.bspr.org.uk/nai.htm
4. Zimmerman S, Makoroff K, Care M, Thomas A, Shapiro R. Utility of follow-up skeletal surveys in suspected child abuse evaluations. *Child Abuse and Neglect*. 2005; 29: 1075-1083.
5. Brody AS, Frush DP, Huda W, Brent RL, and the American Academy of Pediatrics Section on Radiology. Radiation risk to children from computed tomography. *Pediatrics*. 2007; 120: 677-682.
6. 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? *Clinical Radiology*. 2006; 61: 723-736.