



## **CAR Standard for Skeletal Surveys in Children**

### **Approved: June 1998**

These Standards were developed by the Expert Advisory Panel on Pediatric Radiology: Martin Reed, M.D., Chair, Susan Blaser, M.D., Benvon Cramer, M.D., Richard Higgins, M.D., Douglas Jamieson, M.D.

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### **I. INTRODUCTION**

Radiographic skeletal surveys are employed for a variety of clinical problems in children. The most common clinical indication is for suspected child abuse. Skeletal injury is common in infants and young children suffering inflicted injury at the hands of their caretakers. The skeletal survey is frequently critical to the diagnosis and it is often presented as evidence in care and protection cases, criminal proceedings, and other types of litigation. Skeletal surveys are also performed to diagnose skeletal dysplasias, syndromes and metabolic disorders. Certain neoplastic conditions may also be evaluated with radiographic skeletal surveys.

### **II. DEFINITION**

A skeletal survey is a systematically performed series of radiographic images, which encompasses the entire skeleton.

### **III. GOAL**

The goal of performing the skeletal survey is to accurately identify focal and diffuse abnormalities of the skeleton and to differentiate them from developmental changes and other anatomic variants, which occur in infants and children.

### **IV. INDICATIONS**

Skeletal surveys may be performed when the following conditions are considered:

- Physical abuse in infants and young children.
- Skeletal dysplasias, syndromes and metabolic disorders.
- Neoplasia and related disorders

### **V. QUALIFICATIONS AND RESPONSIBILITIES OF PERSONNEL**

#### **A. Physician**

That Physicians involved in the performance, supervision and interpretation of skeletal surveys in children should be Diagnostic Radiologists and must have a Fellowship or Certification in Diagnostic Radiology with the Royal College of Physicians and Surgeons of Canada and/or the Collège des médecins du Québec. Also acceptable are foreign Specialist qualifications if the Radiologist so qualified holds an appointment in Radiology with a Canadian University.

As new imaging modalities and interventional techniques are developed additional clinical training, under supervision and with proper documentation, should be obtained before radiologists interpret or perform such examinations or procedures independently. Such additional training must meet with pertinent provincial/regional regulations. Continuing professional development must meet with the requirements of the Maintenance of Certification Program of the Royal College of Physicians and Surgeons of Canada.

### **B. Radiological technologist**

1. The medical radiation technologist must have the Canadian Association of Medical Radiation Technologists (CAMRT) certification or be certified by an equivalent licensing body recognized by the CAMRT.
2. Under the general supervision of the radiologist, the technologist will have the responsibility for patient comfort and safety, for examination preparation and performance, and for image technical evaluation and quality, and applicable quality assurance.
3. The training of the technologists engaged in specialty activities shall meet the applicable and valid national and provincial specialty qualifications.
4. Continued education of technologists is encouraged by the CAMRT and should meet pertinent provincial regulations.

## **VI. SPECIFICATIONS OF THE EXAMINATION**

The skeletal survey examination should be performed in accordance with the traditional principles of high quality diagnostic radiography. These include proper technique factors, positioning, collimation, image identification, restraining methods, and patient shielding.

The imaging protocol for the skeletal survey will depend upon the particular clinical indication.

### **A. Suspected child abuse**

Each anatomic region should be imaged with a separate radiographic exposure to insure uniform image density and minimize image unsharpness. The portions of each extremity should be radiographed in at least the frontal projection. The axial skeleton should be obtained in two projections. In infants, the entire examination should be performed with a suitable high-detail imaging system.

In the toddler and older child, dosage considerations will require that a general medium speed system, usually employing a moving grid, will be necessary for the larger body regions. Peak kilovoltage should be set at a sufficiently low level to provide adequate subject contrast. The examination should be reviewed by a radiologist, and additional views should be obtained to fully document suspected abnormalities.

### **B. Skeletal dysplasias, syndromes, and metabolic disorders**

The protocol depends upon the diagnosis under consideration.

#### ***1. Skeletal dysplasias and syndromes***

For skeletal dysplasias, including conditions with disproportionate stature (e.g. mucopolysaccharidosis and mucopolipidosis) and a wide variety of syndromes (including many dysmorphic disorders and also some endocrinopathies), the examination should conform to the standard skeletal survey protocol with the following exceptions. Entire arms and legs may be exposed on a single film, when the size of the child permits. Separate views of the skull (frontal and lateral), hands (PA) and feet (AP) are usually necessary. Lateral views of the feet and ankles may be useful in selected cases.

#### ***2. Metabolic disorders***

The standard skeletal survey should be modified and largely curtailed wherever possible. With the most rapid turnover of bone in children occurring at the growth plates of the knees and wrists, frontal projections of a knee and a wrist may suffice. However, in some cases,

the standard skeletal survey will be necessary.

As in VI. A., radiologist review is essential with additional views as required (e.g. flexion extension lateral views of the cervical spine for certain skeletal dysplasias).

#### **C. Neoplasia and related conditions**

A protocol similar to that in VI. A. should be used. Additional orthogonal projections of areas known to be symptomatic or abnormal on bone scan should be obtained.

### **VII. DOCUMENTATION**

A report should provide a concise description of all sites of definite and suspected abnormality. When a constellation of radiographic findings is sufficient to raise strong suspicion of abuse, this should be so stated in the X-ray Report. When these concerns are present, they should be communicated to the referring physician in accordance with the CAR Standard for Communication - Diagnostic Radiology.

### **VIII. EQUIPMENT**

Radiographic equipment should include a general-purpose X-ray unit equipped with small focal spot.

The diagnostic performance of a skeletal survey is a function of the spatial and contrast resolution of the film screen combination. At a minimum, a high contrast general system designed for extremity use with a speed of no more than 200, and a limiting resolution of at least 10 line pairs per millimeter should be employed for all anatomic regions in infants. A low absorption cassette or front plate is recommended to maximize X-ray detection. These systems should be used without a grid. Beyond infancy, faster general-purpose systems will be required for the thicker body regions (e.g. skull, lateral pelvis, and lumbar spine).

### **IX. RADIATION DOSE**

High resolution imaging systems will result in considerable increase in radiation dose over typical low dose systems widely used for general pediatric imaging. When judiciously applied for appropriate indications, this increased dose is justifiable in order to obtain superior skeletal detail. When modern high detail imaging systems are coupled with a meticulous radiographic technique, the patient dose remains well within accepted levels, and the associated risks are extremely small.

### **X. QUALITY CONTROL**

A quality assurance/control program should be established and maintained, which includes daily processor sensitometry, annual radiographic equipment performance evaluation (physicist checks), calibration (technologist checks) and typical patient exposures.

### **XI. QUALITY IMPROVEMENT**

Procedures should be systematically monitored and evaluated as a part of the overall quality improvement program of the facility. Monitoring should include the evaluation of the accuracy of radiologic interpretations, as well as the appropriateness of the examination.

Complications and adverse events should be recorded and periodically reviewed in order to identify opportunities to improve patient care. Accuracy of interpretation also should be recorded and periodically reviewed in order to identify opportunities to improve patient care. These data should be collected in a manner that complies with statutory and regulatory peer-review procedures in order to protect the confidentiality of the peer-review data.