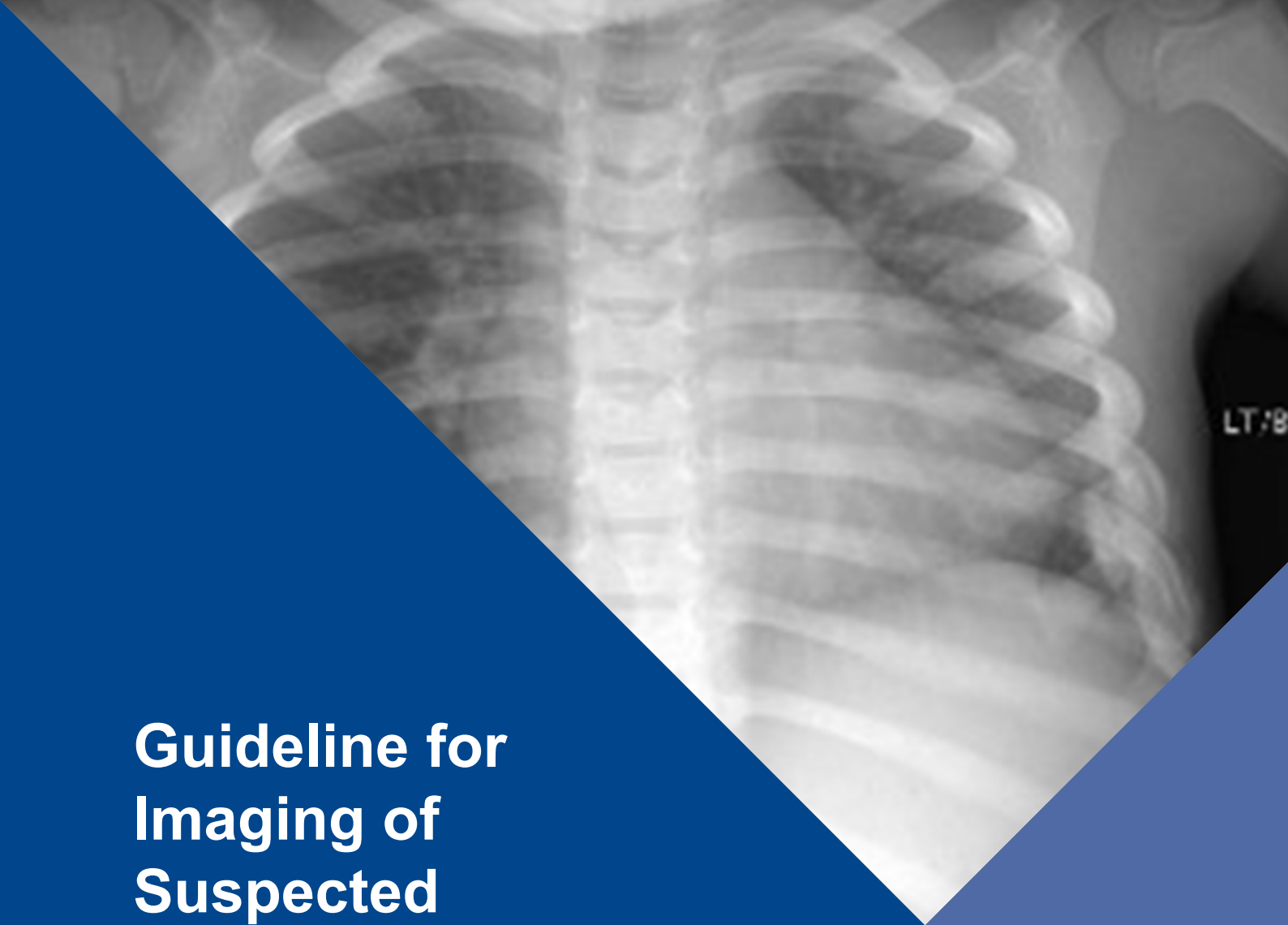

Guideline for Imaging of Suspected Non-Accidental Injury

APPROVED
20 October 2022

The Royal Australian and New Zealand College of Radiologists®

The Faculty of Clinical Radiology

Name of document and version:
Guideline for Imaging of Suspected Non-Accidental Injury, Version 1.0

Approved by:
Council

Date of approval:
20 October 2022

ABN 37 000 029 863

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TABLE OF CONTENTS

About the College

The Royal Australian and New Zealand College of Radiologists (RANZCR) is a not-for-profit association of members who deliver skills, knowledge, insight, time and commitments to promote the science and practice of the medical specialties of clinical radiology (diagnostic and interventional) and radiation oncology in Australia and New Zealand.

The Faculty of Clinical Radiology, RANZCR, is the peak bi-national body for setting, promoting and continuously improving the standards of training and practice in diagnostic and interventional radiology for the betterment of the people of Australia and New Zealand.

Our Vision

To lead best practice in clinical radiology and radiation oncology for the benefit of our patients and communities.

Our Purpose

To drive the safe and appropriate use of radiology and radiation oncology to optimise health outcomes through leadership, education and advocacy.

Our Values

Commitment to Best Practice

Exemplified through an evidence-based culture, a focus on patient outcomes and equity of access to high quality care, an attitude of compassion and empathy.

Acting with Integrity

Exemplified through an ethical approach: doing what is right, not what is expedient; a forward thinking and collaborative attitude and a patient-centric focus.

Accountability

Exemplified through strong leadership that is accountable to members, patient engagement at professional and organisational levels.

Leadership

Exemplified through a culture of leadership where we demonstrate outcomes.

Code of Ethics

The Code defines the values and principles that underpin the best practice of clinical radiology and radiation oncology and makes explicit the standards of ethical conduct the College expects of its members.

1. INTRODUCTION

1.1 Purpose and scope

(a) This Guideline for Imaging of Suspected Non-Accidental Injury is intended to assist The Royal Australian and New Zealand College of Radiologists® (ABN 37 000 029 863) (the College), its staff, Fellows, members and other individuals.

(b) These protocols and guidelines are for imaging in suspected non-accidental injury (NAI) and are based on established standards within New Zealand, North America and the United Kingdom as well as a review of the current literature.

1.2 Definitions

In this Guideline:

College means The Royal Australian and New Zealand College of Radiologists.

Member means a member of the College.

NAI means Non-Accidental Injury.

2. GENERAL PRINCIPLES

Diagnostic imaging plays an essential role in the evaluation of suspected non-accidental injury. Radiologists are obliged to report suspicious injuries and may be the first clinicians to detect an injury of concern[(1)]. It is recommended that radiologists who report paediatric studies are familiar with an appropriate referral pathway for suspected abuse for their specific reporting circumstances. This will depend on whether the imaging practice is in the community, or hospital-based, and what resources are available. Depending on circumstances and location this pathway may include phone advice from a paediatric hospital, or direct referral to a paediatric Child Protection Team.

This document aims to provide the reader with a guideline to assist them in imaging in cases of suspected inflicted injury. It will cover imaging in suspected non CNS injury, (skeletal survey, nuclear medicine bone scan, CT and MRI), and in suspected CNS injury (skull X ray, US, CT and MRI).

3. REFERRALS

The decision to perform imaging in suspected NAI is made only when a clinician has formed a strong suspicion of physical abuse. Subsequently, it is recommended that referral for imaging should only be undertaken after case consultation with senior colleagues who have undertaken training around the detection and assessment of inflicted injury. In larger centres this is usually a group of paediatricians who have a subspecialty interest in this field, however, in smaller practices this may be a paediatrician or emergency physician. Siblings of children in whom injury has been proven and abuse is strongly suspected may also be referred for imaging. This is strongly recommended for multiple birth siblings and siblings under two years of age but, age-appropriate protocols should be followed[(2)].

Imaging should not be performed until a radiologist has approved the request and the forensic nature of the investigation of potential injury should be stated on the request form.

4. SKELETAL SURVEY

4.1 Patient Age

International standards suggest a skeletal survey should always be performed in suspected abuse if the patient is under two years of age[(2-4)]. Between the ages of two and five years, the need for a skeletal survey is dictated by the clinical assessment and it may not be required[(3)]. Above five years the skeletal survey is of little use[(4)]. In all age groups, if there is concern about a fracture of a specific site then the standard trauma imaging assessment of that region should be performed[(4)].

4.2 Timing & Location

A skeletal survey is ideally performed semi-electively and during working hours when experienced staff are available. For weekend and overnight presentations, the child may be able to be imaged the next working day or following the weekend, especially if remaining an inpatient. Out-of-hours radiological assessment may be warranted if it would result in a change in management and/or there are concerns relating to child safety, and these cases should be discussed directly between the referrer and the radiologist. Limitations of an out-of-hours assessment are that a radiologist may not be in attendance to review the imaging at the completion of the survey, and the patient would need to be recalled if further imaging is required. Also, in smaller or more general hospitals, the on-call radiologist may not be comfortable with management being planned on a report that they would prefer to remain interim until further measures become available such as the survey being double read or a paediatric radiologist opinion being given. Imaging should ideally be performed within the Medical Imaging Department, with out-of-department surveys limited to occasions when children are too unwell or unable to attend the Medical Imaging Department for an extended period (e.g. prolonged stay in Paediatric ICU).

4.3 Consent

Consent for a child to undergo a skeletal survey needs to be obtained from the child's legal guardian. The referrer usually obtains consent and the legal guardian needs to be informed that the purpose of the examination is the assessment for possible non-accidental injury. If consent cannot be obtained from the legal guardian, the Child Protection Team will need to liaise with the local Statutory Child Protection Agency to obtain consent by Court Order, however this is infrequently required.

4.4 Radiation Dose

With regards to consent and discussion around dose, a skeletal survey is equivalent to approximately a month of background radiation[(5)].

4.5 Management

Performing a skeletal survey can be a difficult and stressful process for both staff and patients, particularly in smaller centres where these are not routinely performed.

It may be appropriate to liaise with the local paediatrician regarding oral sedation for the child prior to the procedure.

If the child has established injuries such as fractures, analgesia should be administered by the medical team prior to coming to the imaging department for the skeletal survey.

Two radiographers should perform the skeletal survey: preferably both, or at least one, should have imaging experience in the context of suspected non-accidental injury. In addition, a paediatric nurse or other delegated paediatric staff member who is aware that they will be needed to help position and immobilise the child should be present. The decision as to whether to have the parents/carers in the room during the examination will need to be made at a local/departmental level.

Ideally, after the survey has been performed and before the patient leaves the department, the images should be checked by the radiologist who will be reporting the study. Supplementary views (see below) may be requested which are acquired and checked again until the survey is felt to be complete.

Following the skeletal survey, the child needs to return to the care of the referring team.

5. IMAGING – NON CNS

5.1 X-ray – Skeletal Survey (Initial)

The expected quality-enhancing techniques of collimation, appropriate exposure factors and positioning need to be utilised, as the fractures associated with physical abuse in children are often subtle and the likelihood of detection is related to the quality of the radiological studies[6]. A "babygram" (a single radiograph of an entire infant) is not appropriate for assessment of suspected NAI with international standards now recommending multiple targeted views[2, 3].

The proposed protocol of images for the initial skeletal survey in Australia and New Zealand is provided in Table 1 based on protocols from the RCR UK and the NZ national protocol [2, 7]. The protocol presented does not preclude the use of further views should they be required.

Table 1 – Imaging Protocol for the Initial Skeletal Survey

Initial Skeletal Survey
Head, chest, spine and pelvis: Anterior-posterior (AP) and lateral skull if a volume acquired multiplanar CT head with 3D reconstructions have not been performed AP and lateral chest (to include the shoulders and sternum), both obliques (obliques to include all ribs, left and right, 1–12) AP abdomen and pelvis Lateral views of the whole spine. (For children under one year, this maybe possible with one view, for larger children and those over one year, separate views will probably be required.) **Upper limbs:** Where possible: AP of the whole arm (centred at the elbow if possible) Coned lateral elbow Coned lateral wrist Posterior-anterior (PA) hand and wrist **In larger children where a single whole arm view is not possible:** AP humerus (including the shoulder and elbow) AP forearm (including the elbow and wrist) Coned lateral elbow

Coned lateral wrist DP hand and wrist **Lower limbs:** Where possible: Whole AP lower limb, hip to ankle Coned lateral knee Coned lateral ankle Coned AP ankle (mortise view) Coned AP knees DP foot **For larger children** AP femur AP tibia and fibula Coned AP knee Coned AP ankle (mortise view) Coned lateral knee Coned lateral ankle DP foot
<u>Supplementary views:</u> Additional views should be obtained in the following circumstances: - Lateral views of any suspected shaft fracture. - Coned lateral view of sternum when poorly demonstrated on lateral chest X-ray

An AP of the entire upper limb (humerus and forearm) may be able to be included on a single image depending on the size of the child. The same applies to the AP of the entire lower limb (femur and tibia/fibula). Imaging of the hands and feet are performed separately (see below). Ensuring that the knees are not flexed assists in improving image quality and fracture detection.

Inclusion of lateral views has been shown to increase confidence and detection of metaphyseal fractures[8].

Images of each hand can be acquired individually or both hands can be imaged on the same single exposure with the same applicable for the feet. Fractures of the hands and feet are strongly associated with abuse[9, 10].

Oblique views improve accuracy in rib fracture assessment[11, 12] and rib fractures are highly predictive of a diagnosis of NAI in children under three years[13].

The lateral view of the chest also serves to evaluate the sternum; sternal fractures are highly associated with NAI[14].

The cervical spine and thoracic spine may be able to be included on the lateral skull X-ray and lateral chest films respectively.

The skull views do not need to be performed if the child has undergone a recent volume acquired head CT with both multiplanar (axial, coronal and sagittal) as well as 3D volume-rendered (VR) reconstructions as part of their imaging[15].

5.2 X-ray – Skeletal Survey (Limited Repeat)

A limited repeat skeletal survey can be used to detect fractures that were occult on the initial skeletal survey, with injuries becoming evident on the follow-up study in around 10% of cases[16, 17]. The follow-up skeletal survey may also assist in confirming fractures of differing age,[18] and allows further assessment of regions that were initially thought suspicious for fracture(s) so that fracture(s) can be more definitively confirmed or excluded.

The limited repeat skeletal survey omits the skull, pelvis and spine X-rays. [Table 2, (16, 19)]. It comprises imaging of the chest and any abnormal or suspicious areas detected on the initial skeletal survey and it is performed ideally 14 days after the initial study,[2, 3]. It should not be later than 28 days, otherwise the child will need to be reassessed as for an original consultation and a further full skeletal survey may be required[2].

There needs to be clear communication with the referring team about the imaging results as the Statutory Child Protection Agency and Police Service will likely require that the child is placed in what is deemed to be a safe environment while the child protection concerns are fully investigated. This includes the interim between the initial skeletal survey and the limited repeat skeletal survey.

Table 2 – Imaging Protocol for the Limited Repeat Skeletal Survey

Follow-up imaging: 14 days, and no later than 28 days after initial skeletal survey.
Follow-up radiographs should be performed of any abnormal or suspicious areas on the initial skeletal survey plus the following views:
Chest:
Chest AP and lateral and both obliques (to include the shoulders and all ribs, left and right, 1–12)
Upper limbs:
Infants and small children:
AP whole upper limb (centred at the elbow if possible)

- AP hand and wrist

In larger children where whole upper limb views are not possible:

- AP humerus (including the shoulder and elbow)
- AP forearm (including the elbow and wrist)
- PA hand and wrist

Lower limbs:

Infants and small children:

- Whole AP lower limb, hip to ankle
- Coned AP knee
- Coned AP ankle (mortise view)
- DP foot

In larger children where whole lower limb views are not possible:

- AP femur
- AP tibia and fibula
- Coned AP knee
- Coned AP ankle (mortise view)
- DP foot

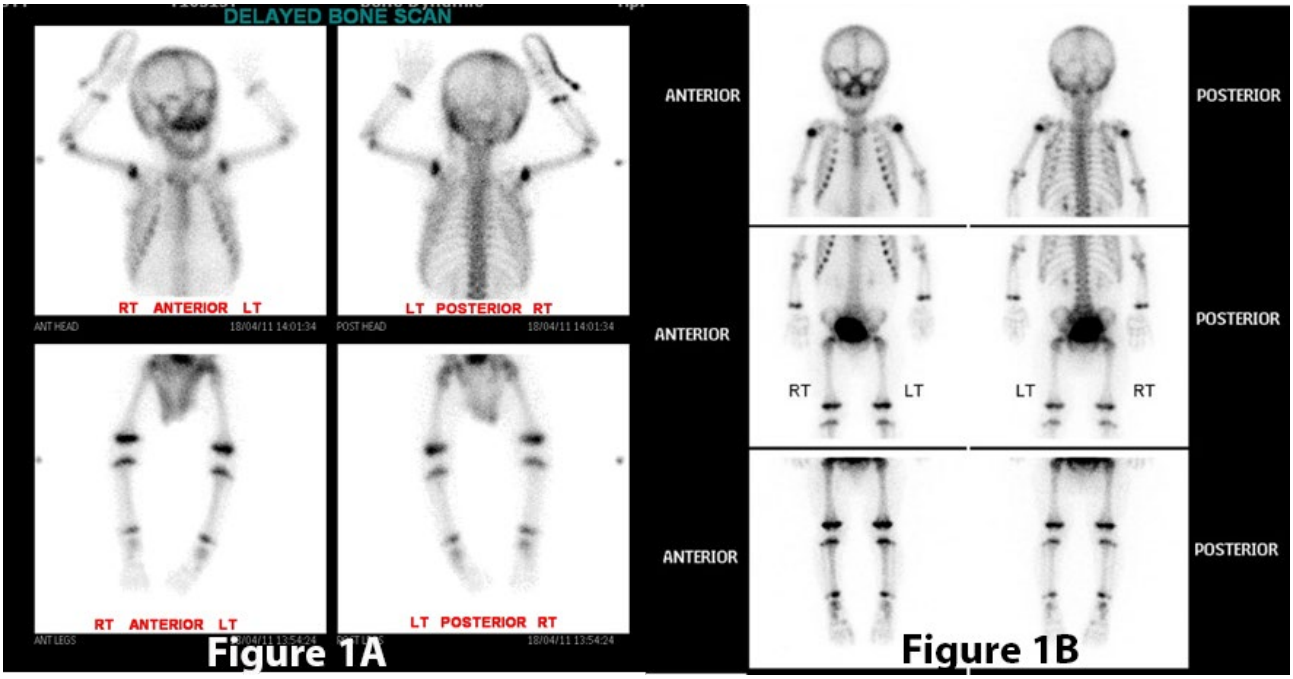
The effective dose of the limited repeat skeletal survey is around one half of the initial survey and approximates to two weeks of background radiation[5]. The limited repeat skeletal survey should follow the same guidelines for Consent, Management and Imaging as described above.

5.3 Nuclear Medicine – Metabolic Bone Imaging

The Nuclear Medicine Technetium 99m diphosphonate bone scan (bone scan) has a complementary role in the assessment of suspected non-accidental injury as it may show increased metabolic activity associated with a radiologically undisplaced fracture[20-22]. The bone scan can detect rib fractures and subtle shaft fractures more sensitively than a radiographic skeletal survey, however skull, metaphyseal and epiphyseal fractures may be missed[20, 23]. The bone scan can also help clarify regions of suspicion on the skeletal survey as either normal or fractured. As the skeletal survey and bone scan are complementary, they should ideally be performed at the same time. A high quality study requires accurate patient positioning and may also require sedation. Sedation reduces motion artefact and also patient and imaging department staff distress. A good quality bone scan has been demonstrated to be positive by one day after fracture in paediatric patients[24].

Adding a bone scan can help to confirm radiographically occult bony injuries at the time of the initial skeletal survey potentially obviating the need for a follow-up skeletal survey two weeks later. It can thus increase the confidence with which radiologists diagnose or exclude injury. More immediate information may help the Child Protection Team and the Statutory Child Protection Agency make decisions about case management and placement of the child and their siblings.

Nuclear Medicine bone scan use is limited in practice because many Medical Imaging Departments do not have experience in performing high quality bone scans on paediatric patients.



Figures 1A and 1B: The same patient imaged for the clinical indication “not walking”; was aged 11 months at the time of the study (1A) and 12 months old when the second study (1B) was performed with sedation. The symmetrical positioning with a still patient in 1B gives better quality images and the abnormal uptake in the right hindfoot is much more clearly seen.

It is easier to perform a clinically useful radiographic skeletal survey than a high quality bone scan. Consequently it is generally recommended to perform initial and follow-up radiographic skeletal surveys rather than a skeletal survey with a bone scan if specialist Paediatric Nuclear Medicine services are unavailable. Another factor for consideration is that the effective dose for a bone scan is higher than a skeletal survey and approximates one year of background radiation[(5)].

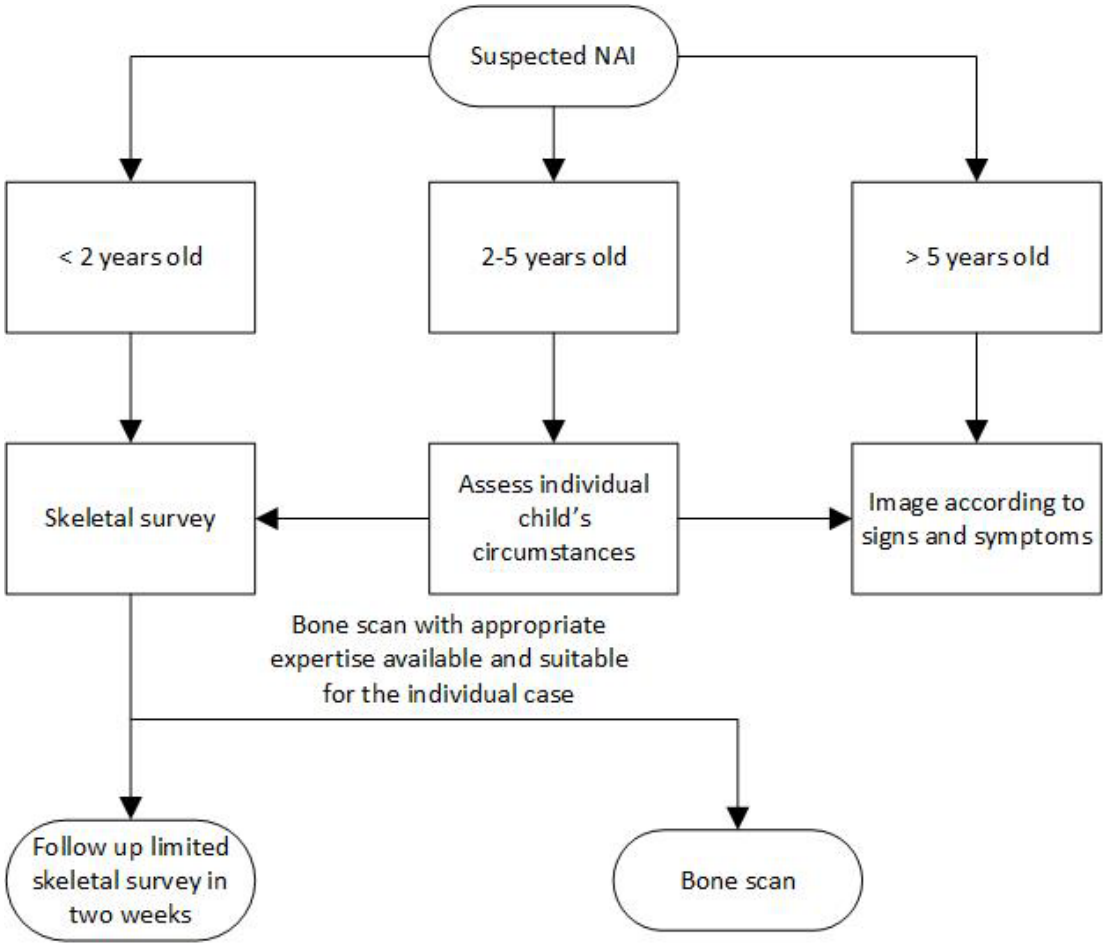
^{18}F-NaF PET (sodium fluoride Positron emission Tomography) Bone imaging has also been used in the assessment of NAI and has been shown to have improved resolution but requires sedation or anaesthesia, due to relatively long imaging times and the requirement for immobilisation, and is not yet widely used. It has been shown to be more sensitive than a skeletal survey for the detection of fractures with the exception of classic metaphyseal lesions[(25)].

A repeat limited skeletal survey may still be considered appropriate after a bone scan, as injuries such as metaphyseal fractures may not become detectable until the repeat skeletal survey is performed.

Discordant results (e.g. the bone scan is abnormal in regions which are normal on the skeletal survey or vice versa) may benefit from further X-rays to assess whether the bone scan has detected an undisplaced acute fracture or a healing/almost healed old fracture. These cases require communication between the Child Protection Team and the Radiologist as well as discussion with the Nuclear Medicine Specialist.

In summary, there are benefits and limitations with both bone scans and limited repeat skeletal surveys. At least one of these should be performed in addition to the initial skeletal survey and the choice will depend on availability, local expertise and the clinical setting (Flow Diagram 1).

Flow Diagram 1 - Recommended Imaging Pathway



5.4 Cross Sectional Imaging for Skeletal Injury

CT has been shown to be more sensitive in the detection of rib fractures than traditional radiography[26, 27]. Currently, the first line imaging assessment of the ribs remains by X-rays within the skeletal survey. There is not enough evidence to recommend chest CT to detect rib fractures as a routine screen at this point until CT dose reduces to be comparable with chest X-ray. Discretionary use of chest CT is recommended, which may be targeted to specific ribs, to clarify abnormalities on chest X-ray or to confirm suspected fractures.

MRI does not currently have a role for the sole detection of skeletal injury,[28] however MRI of the spine performed to assess the CNS (see section 6) may detect vertebral injuries as well as rib fractures (depending on the field of view). Specific imaging sequences, (ultrashort TE or UTE), that are optimised for demonstration of bone are available but further work needs to be done to assess their accuracy for fracture demonstration in various anatomical locations.

5.5 Thoracic Imaging

Traumatic injury to the chest, excluding rib fractures, is relatively uncommon in the setting of inflicted injury[14]. When seen, however, it includes pulmonary contusions, diffuse alveolar damage, traumatic pneumatoceles, laceration and haemo/pneumothorax. Imaging of the thorax is infrequently required beyond what is included in the skeletal survey. However, if there is suspicion of significant trauma to the chest, (e.g. clinical factors such as localised bruising of the chest wall or abnormal findings on the

chest X-ray such as pulmonary consolidation, pneumothorax or mediastinal widening), a CT thoracic trauma protocol should be used[29].

Major intrathoracic injury may occur in the absence of rib fractures due to greater compliance of the paediatric bony thorax[14].

Cardiac injuries although rare, can occur and may involve all layers of the heart. Trauma can result in lacerations/haemorrhage, thrombi and infarcts. Echocardiography can be employed where cardiac trauma is suspected[14].

5.6 Abdominal Imaging

Intraabdominal injury occurs in abuse, but the incidence appears to be significantly less than the incidence of skeletal injury[30, 31]. Abdominal trauma can include injuries to solid organs such as lacerations to the liver, spleen and pancreas, and post traumatic pancreatitis. Hollow viscus injury includes perforation and mural haematomas; the duodenum is particularly at risk of injury due to its relatively fixed position in the upper abdomen[14, 32-34].

A number of clinical flags for intra-abdominal injury have been proposed including bruising, pain, distension, vomiting (including bilious), shock, peritonitis, hypoactive bowel sounds as well as blood in the stool or nasopharyngeal aspirates[3, 32, 40]. However, a reliable clinical diagnosis of abusive abdominal trauma can be confounded by multiple factors including: delays in presentation, lack of a reliable history, absence of external signs, (bruising is absent is up to 25% of cases[32]), and non-specific symptoms such as vomiting that could be attributable to other areas of injury[35]. For this reason biochemical screening for intra-abdominal injury has been suggested, including both liver[36-38] and pancreatic function tests[39].

As with any other blunt trauma case, where intra-abdominal injury is suspected, a CT abdomen/pelvis with IV contrast is the most appropriate imaging modality as long as the patient is haemodynamically stable[3].

While the findings from a CT abdomen may not result in a change in management,[41] traumatic abdominal injuries are the second most common cause of death from abuse after brain injury[14]. Additional information gained from abdominal imaging may be of relevance from the perspective of child protection/forensic medicine[38].

Ultrasound of the abdomen is not recommended as the sole investigation in the acute setting but may be of value as a follow-up tool to ensure resolution of solid organ injury.

Although MRI is not routinely used as a primary imaging modality in the context of abdominal injury, it has been shown to be able to detect intra-abdominal injuries in the context of abuse[28].

Beyond screening and clinical assessment, factors for consideration in the choice of imaging modality include patient body habitus, and local availability of equipment and expertise such as subspecialty paediatric surgical services.

6. IMAGING – CNS

Abusive head trauma is the major cause of death and long-term morbidity from NAI. Ninety-five per cent of serious brain injury in infants is attributed to abusive head trauma[42, 43].

CT and/or MRI should be performed in all children under one year of age with suspected NAI. Children in this age group may have significant traumatic intracranial injury without neurological signs or symptoms or external evidence of head trauma[42, 43, 47, 48].

6.1 Cranial Imaging

6.1.1 Skull X-ray

Skull fractures are commonly seen in the setting of suspected inflicted head trauma. Skull X-ray (SXR) is an important part of the skeletal survey for suspected NAI unless a volume-acquired head CT with multiplanar (axial, coronal and sagittal) as well as 3D volume-rendered (VR) reconstructions have been performed[15], in which case it can be omitted.

The presence or absence of a skull fracture is not predictive of significant intracranial injury. Neuroimaging decisions should be made independently of SXR findings[44, 45].

6.1.2 Cranial Ultrasound

Cranial ultrasound is not an appropriate imaging modality for assessment of abusive head trauma. It has a limited field of view and often fails to detect convexity subdural collections and subtle parenchymal injury.

While cranial ultrasound should not be used in suspected trauma, some infants may present with non-specific neurological findings and cranial ultrasound performed for other indications may reveal intracranial findings raising suspicion of NAI. In this instance they should proceed to CT or MRI imaging.

6.1.3 CT Head

CT head should be performed in:

- Children presenting acutely with either abnormal neurological signs or symptoms, or external evidence of head trauma. It should be undertaken as soon as possible in these cases.

Recommended scan protocol:

- Unenhanced CT scan should cover the entire brain and skull.
- Volume or multislice imaging should be employed with three plane reconstructions.
- Reformatting with both soft tissue and bone kernels in three orthogonal planes for both.
- 3D surface / volume rendered images of the skull should be produced to assist with fracture demonstration.

6.1.4 MRI Head

MRI of the head should be performed in:

- Children whose head CT has demonstrated intracranial injury or skull fracture. MRI provides additional information in at least 25% of children in this group[49].

- Children in whom there is a high suspicion of abusive head trauma or who have persistently abnormal neurological signs or symptoms despite a normal head CT examination[50].

- Children in whom there is suspicion of abusive head trauma, such as retinal haemorrhages or extensive facial/scalp brusing, but who do not warrant a head CT due to absence of both acute neurological symptoms / signs and external evidence of head trauma.

Recommended MR sequence acquisitions should include:

- Sagittal +/- Axial T1
- Axial T2 +/- Sagittal T2
- Axial or Coronal Gradient echo or susceptibility weighted imaging (SWI)
- Axial +/- Sagittal Diffusion weighted imaging (DWI)
- Coronal +/- Axial/Sagittal [T2] Fluid attenuated inversion recovery imaging (FLAIR) FS.

Where necessary MRI imaging should be performed with appropriate sedation or general anaesthesia so that diagnostic images can be obtained. This will often be required in children between three months and about five years of age. Under three months of age, a “feed and wrap” protocol may provide diagnostic imaging.

MRI imaging should be performed at a field strength between 1.5T and 3T, utilising appropriate coils for imaging infants and children.

MRI imaging should be performed by MRI imaging technologists with experience and expertise in imaging infants and children.

6.2 Spinal Imaging

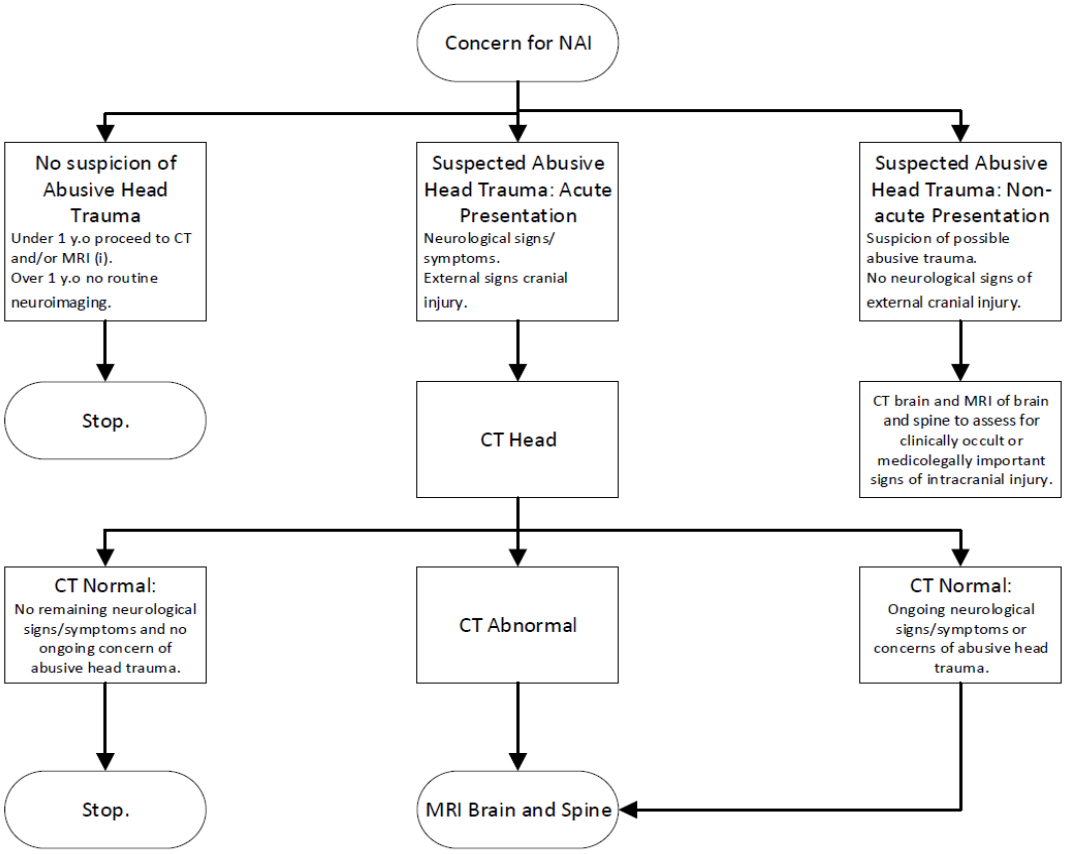
Studies have shown a high rate of clinically unsuspected spinal injury in children with abusive head trauma. This will often take the form of spinal subdural haemorrhage or ligamentous injury which may not be apparent on the skeletal survey spinal X-rays[50-55].

MRI of the entire spine should be performed at the same time as MRI of the head.

Recommended imaging sequences should include:

- Sagittal T1, T2 and short T1 inversion recovery (STIR) or FS T2
- Axial T1 and T2
- Coronal T2 centred on the craniocervical junction.

6.3 Flow Diagram 2 - Recommended Imaging Pathway



7. REPORTING

7.1 Skeletal survey

Where possible, it is recommended that two readers independently review each case and then confer to discuss before the final report is issued. In cases of doubt about the findings, it is important to gain a second opinion/paediatric radiologist report early as inaccurate reports can have dire consequences/legal implications.

Traditionally, the reporting of fractures in suspected cases of non-accidental injury has included an estimated age of the fracture in days/weeks, however, a review suggests there is a lack of evidence in using these methods for fracture dating[56]. Subsequently, recognising and grouping different stages of fracture healing (early or mature) versus an acute injury is a method that can then be used to classify fractures as 'age-different', rather than 'age-correct'[57, 58]. Based on this classification system, fractures can potentially be grouped into categories such as acute, subacute and nearly healed based on their appearance (**Figures 2A, 2B & 2C**). Reporting in a manner such as this is best undertaken following a discussion with the referring Child Protection Team with regards to rationale.

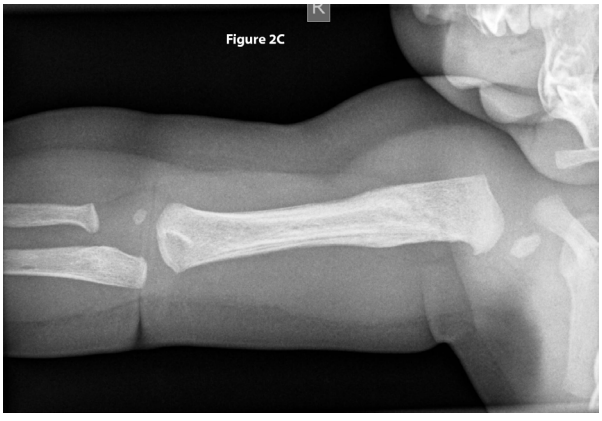


Figure 2A Acute fracture: Well defined fracture line. No signs of healing.

Figure 2B Subacute fracture: Loss of fracture line definition. New bone formation.

Figure 2C Nearly healed fracture: Consolidated callus.

A comprehensive description of the fracture characteristics is often very helpful to the clinicians. This would include the following parameters:

- site (which bone, location)
- fracture type, shape
- features of the fracture line
- soft tissue changes
- periosteal new bone
- callus (type and extent)
- interpretation of stage of healing (acute, subacute, healing, remodelling)
- conclusion.

Some tips for practice are:

1. If no subperiosteal new bone has formed the fracture is less than 11 days old.
2. Most classic metaphyseal corner fractures do not show subperiosteal new bone formation, (unless the fragment is displaced with periosteal stripping), and as such, may not be able to be established as subacute or nearly healed (chronic)[57].
3. Assessment of whether a fracture is subacute or nearly healed (chronic) is also problematic in the skull and spine again due to limited or difficult to visualise callus formation[57].
4. Rib fracture callus is also difficult to visualise in some cases due to constant breathing motion and movement from handling of infants[60] with a recent review suggesting the thickness of the forming callus may be of benefit in assessing the stage of healing[61].

Neurological imaging should be reported in a timely fashion by a radiologist with experience and expertise in paediatric neuroimaging[62].

It is always important to remember that it is not the radiologist's role to work out who inflicted the injury; that is the role of the criminal justice system. The radiologist does have a role initially in identifying findings of concern and notifying the referrer. Further evaluation may be required in providing a professional opinion as to whether the mechanism of injury provided with the clinical history is consistent with the radiological findings, and in assisting the forensic clinicians with regards to the most likely type(s) of injury that may cause the radiological findings.

8. APPENDICES

A. Skeletal Survey Images

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APPENDIX A: SKELETAL SURVEY IMAGES

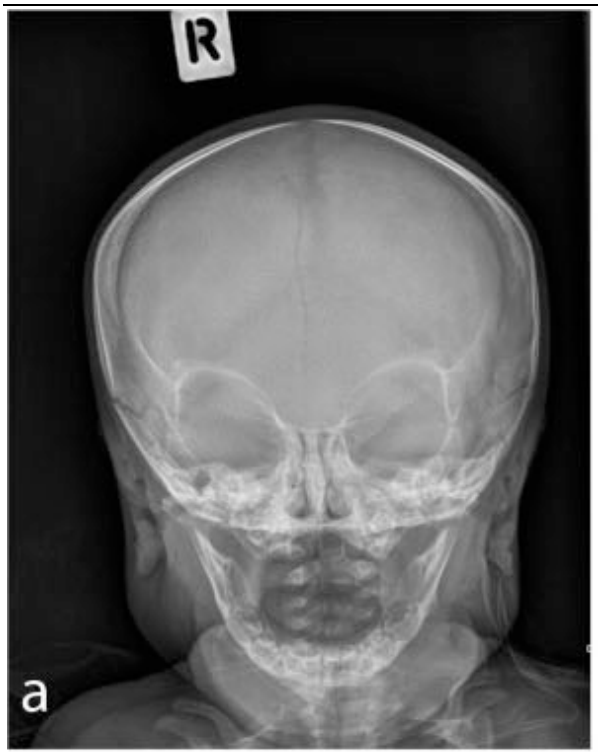

Figure 1: Frontal Skull

Figure 2: Lateral Skull

Figure 3: AP Chest

Figure 4: Lateral Chest

Figure 5: Right Oblique Chest

Figure 6: Left Oblique Chest

Figure 7: Anteroposterior (AP) Abdomen

Figure 8: Anteroposterior Lower Limbs

Figure 9: AP Upper Limb (one side only shown)

Figure 10: Lateral Coned Knee (one side only shown)

Figure 11: AP Coned Knees

Figure 12: Lateral Coned Ankle (one side only shown)

Figure 13: AP Coned Ankles

Figure 14: Dorsoposterior (DP) Feet

Figure 15: Lateral Whole Spine