Pelvic injuries in child abuse

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Abstract. Three cases of child abuse are described in which pelvic injuries were prominent findings on radiologic examination: Two patients had pelvic fractures, and one was found to have heterotopic ossification of the soft tissues of the pelvis and thighs corresponding to extensive bruising in the pubic, genital, buttock, and thigh areas, resulting from physical and sexual abuse. These represent uncommon radiographic findings. Skeletal survey in cases of suspected child abuse should include the entire pelvis, and special attention should be paid to the ischiopubic rami the most common site of these rare pelvic injuries.

Pelvic fractures are rare among the well known radiologic manifestations of child abuse [1–5]. Nonetheless, we report three cases of child abuse in which pelvic manifestations figured prominently. One abused child showed unique heterotopic ossification of the soft tissues of the pelvis and thighs in areas where physical and sexual abuse had resulted in extensive pubic, genital, buttock, and thigh bruising; the two other abused children had pelvic fractures.

Clinical material

Patient 1

A six-and-a-half-year-old Hispanic girl presented with weakness in her right arm and a right clavicular mass. Her past medical history was complicated. Significant in the history was previous pneumonia, pyopneumothorax, and retropharyngeal abscess resulting from a perforated esophagus. In addition, she had ascariasis that resulted in intestinal obstruction and bowel perforation requiring a temporary

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colostomy. Child protective services had prior contact with the child and her family, impoverished illegal aliens from Mexico, for complaints of bruises.

Physical examination revealed an alert, cooperative, afebrile child in no acute distress; her weight was at the 20th and height at the 10th percentiles. There were bruises on the right forehead, left cheek, and both eyelids. A human bite mark was present on the left shoulder. Ophthalmologic exam revealed pigmented maculopathy of the left fovea. A non-tender mass was palpable over the right clavicle. Genitourinary examination clearly indicated past physical abuse and penetrating genital injuries due to sexual abuse. There was extensive bruising of the pubic, genital, buttock, and upper thigh areas (Fig. 1 a), as well as a shining red hypertrophic scar in the right genital area. There were motor, sensory and reflex deficits in the right upper extremity due to brachial plexus nerve palsy.

Laboratory examination revealed an elevated white blood count to 13,300 with 52% polymorphonuclear leukocytes, 8% band cells, 36% lymphocytes, 2% monocytes, and 2% eosinophils; hemoglobin 10.7 g/dl, and hematocrit 32.1% with normal MCV. Creatinine kinase 924 U/l (normal 65–210), LDH 345 U/l (normal 85–165) and AST 84% U/l (normal 5–35) were elevated, probably due to muscle trauma.

A skeletal series, including radiographs of the chest and right shoulder, ruled out clavicular osteomyletitis related to her previous thoracic infections and surgery, as had initially been suspected. The films showed instead a healing fracture of the mid right clavicle with exuberant callus that had occurred in the month since the child's last chest radiograph; it is likely that the injury was non-accidental. Other findings consistent with child abuse could be seen in pleural thickening along the lateral aspects of several right ribs, which showed sclerosis and periosteal reactions. The pelvic and lower extremity portions of the series revealed extensive heterotopic ossification in the soft tissues of the pelvis and both upper thighs, corresponding to the extensive pubic, genital, buttock, and thigh bruising. A periosteal reaction was present along the medial proximal left femur (Fig. 1 b).

The child was treated with physical therapy, placed in protective custody, and discharged to foster care, where all her medical problems have resolved.

Patient 2

A seven-and-a-half-month-old male Hispanic infant was referred for care of multiple body burns in different stages of healing. The mother, denying knowledge of how the burns occurred, alleged that her boyfriend was tending the child when the "accident" occurred.
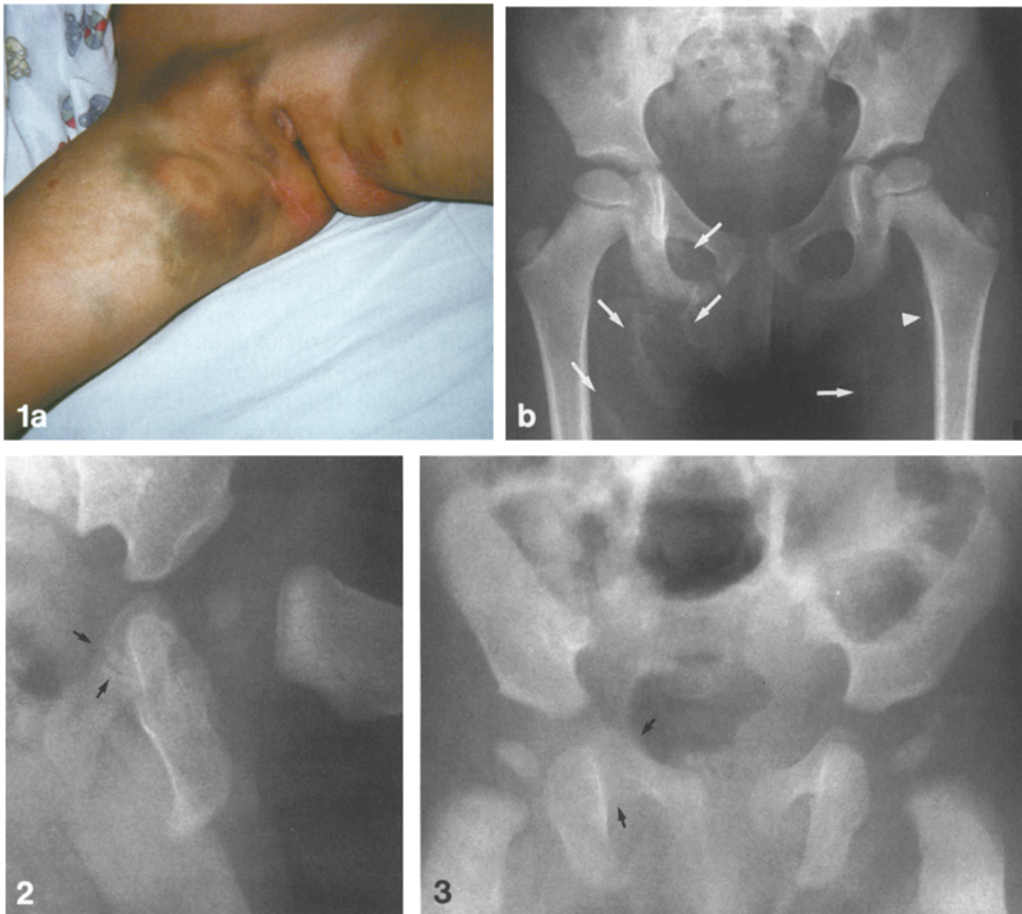
Fig. 1 a, b. A 6½-year-old Hispanic female sustained penetrating genital injuries during sexual abuse
a Extensive bruising of the thigh, buttock, pubic, and genital areas appeared to be of various ages; there was also bilateral hypertrophic scarring
b Anteroposterior radiograph shows extensive heterotopic ossification in the soft tissues of the pelvis and both upper thighs *(white arrows)*, corresponding to the area of extensive bruising. A periosteal reaction is present along the left femoral shaft *(white arrowhead)*

Fig. 2. A 7½-month-old Hispanic male infant sustained multiple body burns of various sizes that appear to be of different ages. Coned lateral view of the left hip shows a healing fracture of the left superior pubic ramus *(black arrows)*

Fig. 3. A 4-month-old infant girl with a history of seizures and crackles in the chest. Anteroposterior radiograph of the pelvis demonstrates asymmetry and poor definition of the right superior pubic ramus reflecting a healing fracture *(black arrows)*

Physical examination showed a sallow-looking child whose weight was at the 25th percentile. He had small first, second, and third degree burns of various sizes and ages on the right and left ears, left cheek, right upper lip, left neck, both nipples, anterior trunk, right thigh, both hands and feet, pubis, scrotum, penis, and the perianal area. An ecchymosis was present over the right anterior thigh. Laboratory data were unremarkable.

A skeletal survey revealed an acute fracture of the mid right clavicle, acute bilateral torus fractures of the proximal tibiae, and a metaphyseal corner fracture of the distal left femur. In addition to these typical injuries of child abuse, there was a healing fracture of the left superior pubic ramus (Fig. 2). A Tc-99m-MDP bone scan, done two days after the skeletal survey, showed increased uptake in the right clavicle, distal left radius and ulna, proximal left humeral metaphysis, proximal and distal left femur, both proximal and shaft portions of the tibiae, and the left superior pubic ramus and acetabulum.

The burns were treated in the hospital without complications. The child was placed in protective custody and discharged to foster care.

Patient 3

A four-month old white female infant was brought to the acute care clinic by her mother because she heard cracking sounds in the child's chest and noted decreased use of the child's right arm. The infant was being treated with phenobarbital for a seizure disorder; there was no history of trauma. Ecchymoses were present over the right chin, right clavicle, and left anterior chest in line with the mid-clavicle at the level of T5–T7. There was crepitus over the left chest. The physical examination was otherwise normal.

Skeletal radiographs revealed the callus of a healing fracture of the distal right clavicle with inferior displacement, acute fractures of the left posterior 7th–9th ribs, and a healing fracture of the right superior pubic ramus (Fig. 3). Increased activity on Tc-99m MDP bone scan was found in the right clavicle near the acromioclavicular joint and in the left posterior 7th–10th ribs near the spine; details of the pelvis on bone scan were obscured by the urinary bladder. The child was placed in protective custody and discharged to foster care.

Discussion

Bone and soft tissue injuries are the most common radiologic manifestations of child abuse. According to Merten and co-workers, fractures are present in 36 % of physically abused patients and represent 83 % of all abuse-related injuries identified by radiologic imaging [4, 6]. Pelvic fractures related to physical abuse, as described in our second and third patients, however, are rare [1–5].

In an early report on multiple traumatic skeletal lesions in infants, Jones and Davis described a two-year-old child abuse victim who sustained a pelvic injury that showed a periosteal reaction along the right ischium and pubis, as well as six associated metaphyseal lesions of the long bones [2]. No rib, skull, or long bone shaft fractures were found, but a calcified hematoma was present adjacent to the left femur. Among the 74 abused children, more than three fourths of whom were less than 3 years old, included in Akbarnia and colleagues' report, there were 264 frac-

tures, only two of which were pelvic (ischiopubic) [3]. Similarly, Merten and co-workers found only two pubic rami fractures, one of which was clinically unsuspected, in 494 children with clinical evidence of physical abuse [4], and Caniano and colleagues [5] identified one pelvic fracture in a survey of the surgical management of 256 abused children.

The latter study, it is interesting to note, calculated the mean age of skeletal injury at 2 years, while the mean age of sexually abused children was 6.6 years [5]. Pelvic injuries are most often seen in children younger than 3 years; only 20 % of children were older than 3 years and only 10 % older than 5 years [3, 4].

The soft tissue injuries of our first patient represent unique radiographic findings. No similar description of such extensive heterotopic pelvic soft tissue ossification resulting from physical and sexual abuse could be found in the literature. Most calcified hematomas in child abuse are associated with adjacent healing fractures, although the calcified hematoma described in Jones and Davis' patient was not associated with a fracture of the adjacent proximal femur [2] and Merten and Carpenter reported an extensive calcified hematoma on CT and MRI in the right gluteal muscles and adjacent soft tissues of an 18-month-old child abuse victim [6].

The American Academy of Pediatrics, Section on Radiology, Diagnostic Imaging of Child Abuse, recommends a skeletal survey as mandatory in all cases of suspected physical abuse in children less than two years of age [7]; patients between two and five years should be handled individually. In children over five years, a screening skeletal survey is of little value because fractures are rarely present without clinical evidence of abuse [4]. However, the customary protocol for imaging a region should be used at any age when clinical findings point to a specific site of injury [7].

Although pelvic injuries are rare, our experience argues for including the entire pelvis in the skeletal survey of the abdomen in suspected child abuse. Usually, the clinical and radiographic diagnosis of child abuse is obvious when the more typical findings of the syndrome are present such as metaphyseal corner fractures, posterior rib fractures or fractures in different stages of healing. It is conceivable, however, that the first signs of pelvic trauma might be discovered during radiologic examination of the pelvis performed for another reason, in which case the pelvic injuries may not be regarded as related to physical or sexual abuse. In the review of films, special attention should be paid to the ischiopubic rami, the most common site of these rare pelvic fractures in abused children. One should be aware, however, of developmental variations that may mimic fractures. On plain radiographs, a normal radiolucent or expanded ischiopubic synchondrosis should not be misinterpreted as a pelvic fracture. Also, according to Caffey [8], the superior pubic ramus may develop from multiple ossification centers which result in vertical clefts, unilateral or bilateral, in 1 % of healthy newborn infants. These clefts usually disappear completely during the first weeks of life but may persist longer. Obviously, clinical correlation is necessary to distinguish a fracture from a normal variant. Because bone scintigraphy may show in-

creased uptake at the site of a normal ischiopubic synchondrosis, clinical correlation with the scintigraphic findings is also necessary and important [9].

In addition to plain film radiography, computed tomography (CT), magnetic resonance imaging (MRI), and bone scintigraphy are useful in evaluating bone and soft tissue injuries in suspected physical child abuse and in deciding among the differential possibilities. CT is the most effective modality for assessing the location and extent of blunt injuries of the abdominal viscera and soft tissues in child abuse, although duodenal and jejunal hematomas can be more readily detected on an upper gastrointestinal series [6, 10–15]. Blunt abdominal injuries, which usually occur in the mid and upper abdomen, account for only 3 % of all injuries in child abuse [6] and occur predominantly in children over two years of age [6, 11, 12, 14–16]. Injuries range from traumatic pancreatitis, pancreatic pseudocyst, retroperitoneal hematoma and hemorrhage, intestinal hematoma, and laceration of the pancreas, spleen, liver, or kidneys [6, 10–16]. CT is also valuable in demonstrating the extent of calcifications and in detecting intraperitoneal blood or air. In light of our experience, just as in the skeletal survey, pelvic CT scans should be carefully scrutinized for pelvic bone or soft tissues injuries related to physical or sexual abuse.

MRI has shown itself to be effective in demonstrating the extent of soft tissue injury and in estimating the age of a hematoma or hemorrhage. Bone scintigraphy is a particularly valuable aid in disclosing unsuspected sites of earlier skeletal injuries and is helpful in confirming bony lesions that may be occult or subtle on plain films.

In summary, we would like to underscore that pelvic injuries, although rare, are a component of the child abuse syndrome. When plain films, CT or MRI yield abnormal pelvic findings, the possibility of child abuse should be entertained in the differential diagnosis and the radiologist is cautioned to be alert for these uncommon manifestations. Clinicians and radiologists should be aware of the direct relationship between child abuse and pelvic abnormalities, particularly in cases of suspected sexual abuse. A radionuclide bone scan, ordered as the next imaging procedure, may disclose the silent sites of previous abuse.

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