REVIEW ARTICLE

Fractures in children younger than 18 months

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KEYWORDS
Obstetrical fracture; Toddler fracture; Non-accidental fracture; Battered child syndrome; Bone fragility

Summary Fractures in children younger than 18 months occur before the usual walking age. The prognosis is favourable across fracture types and circumstances of occurrence. The cause is obvious in obstetrical injuries, whose risk factors have been well documented. Diaphyseal fractures are easy to recognise, whereas challenges may arise with the diagnosis of physeal injuries. Fractures occurring after the neonate is discharged home may be due to accidental falls related to clumsiness on the part of the carers. Other possibilities, however, are child abuse and abnormal bone fragility. Thus, the aetiological diagnosis has major medical, social, and legal implications. Identifying the aetiology is often extremely difficult and benefits from the involvement of a multidisciplinary team. The literature review presented herein is designed to assist orthopaedic surgeons in the diagnosis and management of children with fractures before 18 months of age, in compliance with French legislation, which has undergone major changes over the last quarter century.

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The goal of this article is to review the circumstances that can cause fractures in infants and toddlers younger than 18 months of age. We searched the literature for data on obstetrical injuries, child abuse, bone fragility syndromes, and accidental fractures due to clumsiness on the part of the carers. We will not discuss obstetrical brachial plexus injury, which deserves a separate review.

We chose 18 months as the age cut-off, as the risk of accidental injuries from falls while walking alone is greater after this age, whereas child abuse is most common in younger infants. In addition, rapid healing is the rule after orthopaedic treatment of fractures before 18 months of age.

The role of the orthopaedic surgeon is to diagnose the nature of the lesion, treat the fracture and, above all, determine whether the injury was accidental or due to another cause.

Obstetrical fractures

Few orthopaedic studies are available on obstetrical fractures. Most of the data come from studies by obstetricians and neonatologists.

Epidemiology

In the US, the overall incidence of birth injury in singleton infants (including hematomas, lacerations, fractures, and other injuries) was 2.45/1000 live births, with 9% of...
clavicular fractures, 4% of brachial plexus palsies, and 1.3% of other skeletal injuries [1]. In a university-hospital maternity unit in Paris, France, the incidence of birth injury was 14.2/1000 live births in the 1970s [2].

At our institution, which provides care to women with high-risk pregnancies, among the 4293 neonates born alive in 2011, seven had fractures, for an incidence of 1.63/1000. All seven neonates had clavicular fractures; one neonate also had brachial plexus palsy and another facial palsy. They were all delivered vaginally in the cephalic presentation; shoulder dystocia was reported for 4 of them.

Risk factors

Risk factors for long-bone fractures are caesarean delivery, breech presentation, and low birth weight [3]. The only fracture more common in vaginal deliveries is clavicular fracture [1]. Risk factors for femoral fractures are twin pregnancy, breech presentation, premature delivery, and osteoporosis. Dystocia is often reported in the medical charts [4].

Fracture types

Long-bone fractures usually affect the diaphysis and are generally easy to diagnose. A cracking sound may be heard during delivery. The neonate shows signs of pain upon mobilisation and does not move the affected limb. The radiographs exhibit suggestive abnormalities. The most common site is the clavicle (Fig. 1a and b), followed by the femur (Fig. 2a and b) and humerus. Neurological complications are exceedingly rare and resolve spontaneously [4]. Congenital pseudarthrosis of the clavicle is a differential diagnosis.

Physial injuries are far less common and more difficult to detect. Before the development of the secondary ossification centre, loss of the normal articular relationships should be sought by ultrasonography (Fig. 3), magnetic resonance imaging (MRI), or arthrography in a neonate with a dis tended or apparently dislocated joint. Physial injuries have been reported at the proximal and distal humerus, femur, and tibia [4,5]. The main differential diagnoses are septic arthritis and palsies. The early development of a periosteal callus confirms the fracture.

Abuse or accident?

An abundant literature has been written since it was first recognised that parents or other carers sometimes neglect
or abuse children. The orthopaedic surgeon is in a unique position to diagnose abuse, as fractures are the second most common injuries in this situation, after soft-tissue lesions such as bruises and burns. Damage to the brain and other inner organs is less common but carries a poor prognosis. Mean age of abused children has ranged across studies from 6 to 16 months [6,7].

Historical overview and epidemiology

Abuse of very young children has always existed, although its manifestations have varied over time. The French forensic physician Tardieu, born in 1818, wrote the first description of child abuse [8]. He studied the facial features of abused children and noticed that rapid changes occurred when the children were removed from their families. His work generated little or no attention during his lifetime.

In the early 20th century, interest in child abuse waned despite studies by two other French scientists, the forensic physician Parisot and the paediatrician Caussade. Finally, in 1953 the American radiologist Silverman reported three cases of unexplained fractures in infants and boldly hypothesised that parents sometimes deliberately injure their children [9]. In 1962, Kempe defined radiological criteria for "battered-child syndrome" [10], leading the general public and medical community to recognise the existence of child abuse. Legislation designed to protect children from abuse was passed in all Western countries. In 1974, Caffey identified whiplash shaken-infant syndrome [11]. The French paediatrician Robert Debré met Silverman in the US and used the term "Silverman’s syndrome" in his descriptions of child abuse, although "Tardieu’s syndrome" would have been a more historically accurate name [12].

In an international literature review, the incidence of fractures due to child abuse was 4/10 000 among children younger than 18 months of age. Before 1 year of age, one out of every three fractures on average is non-accidental, compared to one of nine fractures before 18 months of age and one of 205 fractures between 19 months and 5 years of age [13]. In a paediatric emergency department in the US, the proportion of limb fractures due to abuse varied significantly across age groups, from 32% in children younger than 18 months to 2% in older children [14].

The French child-abuse surveillance system (Observatoire national de l’enfant en danger [ONED]) reported that 1.86% of all minors were under child-protection rulings, indicating a slight decrease since 2003, with marked variations across districts. The non-profit organisation Enfance et Partage has reported that two children die in France each year from injuries due to abuse. Child abuse manifests more often as physical abuse (26%) or neglect (26%) than as psychological abuse (22%), sexual abuse (16%), domestic abuse (3%), or other events (4%).

At our institution, Child Protective Services studied 32 cases in 2011. One of these cases was a 7-month-old infant with an unexplained femoral fracture (among 22 450 children seen at the surgical emergency department) that was reported as "information worthy of concern".

French legislation on child abuse

Although child abuse is not defined by French legislation, article 19 of the Convention of the Rights of the Child adopted by the UNO on November the 20th 1989 defined child abuse as "physical or mental violence, injury, or abuse, neglect or negligent treatment, maltreatment or exploitation, including sexual abuse [...]". In general, French legislation requires that individuals who become aware of possible abuse to a child take action by making a report to the appropriate authorities. Article 434-1 of the French Penal Code requires that the judicial or administrative authorities be informed of any crime that an individual is aware of and whose effects could still be prevented or limited or whose perpetrators might commit further crimes that could be prevented. Similarly, article 434-3 requires that an individual communicate to the authorities any knowledge of deprivations, maltreatment, or sexual abuse experienced by a minor younger than 15 years of age or a person who is incapable of self-protection [...]. Furthermore, the law allows for the prosecution of individuals who fail to prevent either a crime or an offence against the bodily integrity of another person (article 223-6, line 1) or who fail to lend assistance to a person who is in danger (article 223-6, line 2).

The first French child-protection law designed to protect children who were "maltreated or morally abandoned" was issued on July 24th 1889. A subsequent addition to the French Civil Code was the law of December 23rd 1958 allowing interventions to protect children whose health, safety, or morality was in jeopardy. The law of July 10th 1989 designed to prevent the maltreatment of minors and to ensure the protection of children updated and strengthened the means available to the authorities. In 2002, Kohler et al. reviewed French legislation [15]. Since then, the law of January 2nd 2004 has provided structure to child protective services and the law of April 4th 2006 has reinforced the prevention and prosecution of domestic violence and of violence against minors. Finally, the law of March 5th 2007 reformulated child protective services and created units for the collection, processing, and evaluation of "information worthy of concern" in each district of France (Cellules départementales de Recueil, de traitement et d'évaluation des Informations...
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Préoccupantes [CRIP]). This law replaces the critical terms “abuse” and “maltreatment” by the term “child who is, or may be, in danger”.

In the French code of medical deontology, articles R.4127-43 and R.4127-44 of the public health code indicate that physicians should protect children whose health seems misunderstood or inadequately preserved by the family: when a physician sees a minor who is the victim of abuse or deprivation, he or she must use the most appropriate means to protect the minor, while exercising caution and circumspection. No punitive action can be taken as a result of abuse or deprivation being reported by a physician to the appropriate authorities. In this situation, article 226-14 of the French penal code specifies clearly that patient confidentiality rules do not apply.

Risk factors, protective factors, and warning signs

These data are of statistical usefulness only, as any child in any environment can be the victim of abuse.

Risk factors are related to the family (difficult living conditions, social isolation, or very young parents), the perinatal period (unreported, closely spaced or multiple pregnancy, early separation of the neonate from the mother), or the child (unwanted pregnancy, preterm birth, disabled child, or child exhibiting challenging behaviours).

Protective factors are the factors related to the potential of the parents and environment to ensure the protection of the child.

Warning signs include absence of regular health visits, developmental delay, and fearful or shy behaviour on the part of the infant. The presence of more than one warning sign may indicate that the child is in danger.

Diagnosis

Fractures in children younger than 18 months are usually diagnosed in the emergency room. The child is brought in by the parents or another caregiver. Several items of the clinical interview can suggest a non-accidental injury:

- the stated reason for the visit may bear no relation to the injury, which is discovered fortuitously;
- there may be a long time from symptom onset to the visit;
- the mechanism of the injury may be unexplained, or the explanations given may seem inconsistent with the fracture, in children who are too young to explain what happened;
- the reported circumstances of the injury may vary across individuals or over time;
- the child may have a history of injuries or of frequent emergency-room visits.

Clinical presentation

A thorough clinical evaluation should be performed by a multidisciplinary team. The spontaneous attitude of the child should be recorded, as well as tone, the relationship with the environment, and active and passive movements. Each bone segment should be palpated to look for pain and the

Figure 4 Sites of skin lesions that are more or less suggestive of abuse.

skin should be examined for more or less suggestive lesions (bruises, finger marks, or burns) (Fig. 4). Evidence of neglect regarding basic care may include failure to thrive, developmental delay, and an unkempt physical appearance.

When a non-accidental injury is suspected, admission of the child should be recommended to the parents [16]. Admission removes the child from a dangerous situation that might result in fatal injuries and provides the best possible conditions for conducting the clinical and social evaluations, performing the necessary investigations, and initiating the treatment. Abuse should be strongly suspected if the parents refuse the admission of their child. When abuse is suspected and admission is refused during the night shift, the hospital administrator on duty should be called in.

The paediatrician performs a general and neurological evaluation, the radiologist obtains the necessary imaging studies, and the social worker collects information on the family’s usual living conditions. Depending on the symptoms, the evaluation may involve an orthopaedic surgeon (in the event of fractures), an ophthalmologist (to perform funduscoppy), a neurosurgeon (to assess brain damage), a maxillofacial surgeon, and/or a gynaecologist if needed.

Radiographic survey

Imaging studies are a crucial component of the evaluation for suspected child abuse, as fractures are found in half the cases. Multiple fractures, especially of different ages, support a diagnosis of abuse (Fig. 5a and b). The skeletal survey should include antero-posterior views of the upper limbs, lower limbs, and pelvis, as well as antero-posterior and lateral views of the spine, rib cage, and skull [6].

In a study of abused children having a mean age of 16 months, multiple fractures were found in half the cases and fractures of different ages in 13% of cases [7]. Radiographs disclosed acute fractures in 77% of cases. The sites
involved were the long bones (21%), ribs (10%), skull (7%), and clavicles (2%). Fractures of the spine, pelvis, and hands are exceedingly rare [6,7]. Obtaining follow-up radiographs has been proved useful for diagnosing fractures of the ribs and long bones, where the signs of fracture healing that allow the diagnosis may require time to develop.

The femoral shaft is the most common fracture site at the lower limbs in children younger than 18 months (Fig. 6a–e) [14]. Before 15 months of age, a spiral fracture line is the most common pattern [13].

The tibial shaft is the second most common fracture site at the lower limbs. In children younger than 18 months, 96% of tibial shaft fractures may be related to abuse [14].

A fracture of the humeral shaft, when combined with other fractures and a suspicious history, was significantly associated with abuse in children younger than 15 or 18 months depending on the study. In contrast, supracondylar fractures and forearm fractures are usually due to accidental falls [13].

Rib fractures are best seen on oblique chest radiographs. Rib fractures that are not related to high-energy trauma are non-accidental in 71% of cases. However, factors associated with bone fragility also commonly result in rib fractures [13].

Metaphyseal fractures are less common but are considered highly specific of abuse. Corner or bucket handle fractures may be painless to palpation (Fig. 7). Other fractures in this category include bilateral rib fractures, fractures of the scapula, complex skull fractures [13], fractures of the distal fourth of the scapula, vertebral fractures and subluxations, finger fractures in children who have not yet learned to walk, fractures of different ages, and bilateral fractures [17].

The simultaneous presence of multiple fractures of differing ages suggests abuse. Consequently, care should be given to assessing this sign. Few reliable data have been published. Prosser et al. indicated criteria for dating fractures in children younger than 5 years of age: periosteal reaction seen as early as day 4 and present in 50% of cases before week 2 after the injury, and remodelling peak at week 8 [18]. Carty reported that 4 to 21 days were required for a periosteal reaction to become apparent, 10 to 21 days for fracture line obliteration, 14 to 90 days for appearance of a bone callus, and 3 months to 2 years for remodelling [17].

Radiological pitfalls include the presence after multiple injuries of a large bone callus suggesting pandiaphyseal osteomyelitis. A periosteal reaction may be a normal variant in infants aged 6 weeks to 6 months, in which case it remains thin and confined to the medial edge of the shaft.

Ultrasonography performed by a trained radiologist may detect fractures missed by standard radiography or rule out lesions suspected radiologically [17]. Bone scintigraphy (Fig. 8) is also valuable for detecting recent or old rib fractures that are suspected clinically [19]. MRI, which often requires general anaesthesia at this age, is effective in detecting slippage of non-osified epiphyseal centres (Fig. 9a and b). Positron-emission tomography (PET) scanning was recently found to be highly sensitive [20]. Nevertheless, nuclear medicine methods lack reliability for detecting metaphyseal lesions, as the neighbouring growth plate is characterised by high radionuclide uptake.

**Management**

**Medical-surgical evaluation**

A multidisciplinary evaluation is indispensable. The child’s parents, other family members, and family friends should be interviewed, as well as any professionals involved with the child, including physicians, social workers, and nurses. French recommendations issued in 2003 (Guide de bonnes pratiques pour les enfants victimes d’infractions pénales) indicate that specialised units should be available for evaluating child abuse. However, such units are not yet available in all healthcare facilities.

In our university paediatric hospital, Child Protective Services review the cases submitted by a healthcare professional working in the hospital. Child Protective Services
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work in close collaboration with the local well-child clinics network, childhood welfare agency, and usual family physician.

Medico-legal implications: the role of each person involved

Once the evaluation is complete, a document can be written to supply information on the identity of the child, as well as a descriptive medical certificate for the administrative or judicial authorities. Then, the procedure depends on whether the child is considered to be at risk for potential harm or exposed to potential harm.

When the child is believed to be at risk for potential harm, a healthcare professional or social worker (or a teacher for older children) communicates an "information worthy of concern" to the president of the district-governing body, who can then ask the local social services, well-child clinics network, or childhood welfare agency to evaluate the level of danger to which the child is exposed and to define the needs of the child and family.

Children who are believed to be exposed to potential harm must be reported to the judicial system via the public prosecutor. Such a report is usually made after the district authorities have finished to process an "information worthy
Figure 8 Bone scintigraphy in an abused child with fractures of several ribs and of the right humerus and tibia.

of concern". In emergencies, the public prosecutor can be asked directly to protect an abused child. The public prosecutor assesses the nature of the offences brought to his or her knowledge and can order temporary foster care of the minor, for up to 8 days.

The children’s court judge may either cancel or confirm the foster-care order and may order home educational assistance and/or educational investigation and orientation measures to better understand the situation.

Prevention

Caution mandates that a child who does not yet know how to walk and who presents with a fracture may be in danger, until proved otherwise, as 80% of non-accidental fractures occur before 18 months of age [21]. During the very first evaluation by the emergency-room physicians, any evidence suggesting non-accidental lesions must be recorded in the medical chart.

Admitting the child at the slightest doubt gives the healthcare team time to discuss the case and to gain some perspective before determining that the child is being abused or has a bone fragility syndrome or simply sustained an accidental fracture. These three diagnoses result in very different management strategies and social implications.

Discussing the case with a child protective services committee or a medical-judicial unit is a wise measure that leads to the parents receiving the decision from a team and not from a single clinician. This point is important, as the orthopaedic surgeon will treat and follow the child for several months or years. The attention given to the child and family can prevent the occurrence of future abuse, which may nevertheless occur in children who also have bone fragility syndromes, resulting in a highly complex situation.

Fractures and bone fragility syndromes

Unexplained fractures occurring before 18 months of age should lead to a search for the differential diagnoses of child abuse. According to the literature, the most common source of misdiagnosis is osteogenesis imperfect (OI) [22], particularly in infants, as illustrated by several recently published cases in France. The main other causes of bone fragility are metaphyseal dysplasias, calcium-phosphorus metabolism disorders, and preterm birth.

Pathogenesis

OI is a group of genetic disorders caused in 95% of cases by mutations in the collagen type 1 gene. Autosomal
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Figure 9 Physisal lesion of the femur in a 6-month-old; a: radiograph of the pelvis; b: MRI in the same patient.

Figure 10 Severely preterm baby (born at 26 weeks gestational age) who required high-dose glucocorticoid therapy for neonatal respiratory distress syndrome: this chest and abdomen radiograph unexpectedly revealed fractures of the left proximal humerus and right proximal femur that are undergoing healing.

Description

The first sources of evidence suggesting OI are the family history and physical examination. The currently used classification system was developed by Silence [29] then completed by Glorieux [23]. Dentinogenesis imperfecta is a common feature but can be detected only after the eruption of primary teeth. Table 1 [30] lists the features of the four main types of OI. An atypical presentation will suggest the diagnosis to physicians who have experience with congenital bone diseases. However, in mild forms with only some of the usual symptoms, the diagnosis is a challenge whenever an unexplained fracture occurs. Type IV encompasses a variety of different patterns and is the most challenging form to diagnose in a child with a first unexplained fracture [26]. Evaluations by a geneticist, a rheumatologist, and a paediatric radiologist are extremely helpful. Genetic testing is not performed in every case but is used instead to complement the clinical assessment with a scientific goal, before conception or when medicolegal issues arise. When a mutation is identified, a diagnosis of OI is given and genetic counselling is provided. Negative genetic tests do not rule out the diagnosis, as the possible mutations are very numerous and are not all identifiable using currently available techniques.

In OI, diaphyseal fractures are common and located at the apex of the bowing antero-lateral deformities of the femurs or tibias, where osteopenia is a striking feature (Fig. 11). The most severe cases involve the upper limbs, spine (kyphoscoliosis), and skull (triangular shape). Multiple rib fractures constitute a life-threatening complication. The co-existence of fractures of different ages suggests the diagnosis but is also consistent with child abuse.

In preterm babies, fractures may occur in any of the long bones, although the ribs and upper limbs are

dominant inheritance is the rule, although de novo mutations and recessive inheritance occur also. The prevalence of OI has been estimated at 1/10,000 to 1/20,000. The main features are bone fragility, short stature, joint laxity, osteopenia, presence of wormian bones, and a number of inconsistent signs related to the abnormal collagen present in numerous tissues [23].

Preterm birth is associated with an excess risk of fractures compared to full-term birth, as a result of physiological, metabolic, and environmental factors (Fig. 10). Fractures in preterm babies usually occur within the first year, and their frequency is variable [24].

Rickets manifests as defective growth-plate mineralisation. Vitamin D deficiency is the most common cause, with risk factors being preterm birth and a dark skin colour [24]. The results of calcium and phosphorus assays, together with the radiographic findings, assist in the diagnosis.

Temporary brittle bone disease is a controversial entity. It has been described as the occurrence of rib and metaphyseal fractures in the first year of life, usually with no symptoms, and with negative investigations for OI and abuse. Immobility during foetal life and deficiencies in copper and/or vitamin C have been implicated [25,26].

The other rare causes of bone fragility do not cause fractures in the first 18 months of life. They include infantile/juvenile osteoporosis; mineral and bone disorder due to chronic kidney disease (CKD-MBD); bone disease due to intestinal disorders; osteopetrosis; leukemia; hypophosphatasia; deficiencies in vitamins A, C, and D; and biliary atresia [27,28].
Table 1 Features of the four main types of osteogenesis imperfecta [30].

<table>
<thead>
<tr>
<th>Type of OI</th>
<th>Severity</th>
<th>Fractures</th>
<th>Osteoporosis</th>
<th>Stature</th>
<th>Sclera</th>
<th>Dentinogenesis imperfecta</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Mild</td>
<td>Not very common, when the child starts to walk</td>
<td>Fairly moderate</td>
<td>Near-normal</td>
<td>Blue</td>
<td>Type I B 25%</td>
<td>Limited deformities Early hearing loss</td>
</tr>
<tr>
<td>II</td>
<td>Lethal</td>
<td>Multiple intra-uterine</td>
<td>Major</td>
<td>—</td>
<td>Dark blue</td>
<td>—</td>
<td>Short limbs with deformities Respiratory insufficiency</td>
</tr>
<tr>
<td>III</td>
<td>Severe</td>
<td>Common, start at birth</td>
<td>Marked</td>
<td>Very short</td>
<td>Variable in colour</td>
<td>Type III B 80%</td>
<td>Bone deformities Triangular face Hearing loss</td>
</tr>
<tr>
<td>IV</td>
<td>Moderate</td>
<td>May be common</td>
<td>Moderate</td>
<td>Short</td>
<td>Variable in colour</td>
<td>Type IV B 60%</td>
<td>No early hearing loss</td>
</tr>
</tbody>
</table>

predominantly affected. Risk factors include parenteral nutrition, diuretics, glucocorticoid therapy, and physical therapy [31].

The main feature of vitamin D deficiency rickets is an abnormal appearance of the metaphyses, which are hazy and ill defined, with fraying, cupping, and flaring towards the growth plate, which appears wider than normal. The epiphyseal ossification centres are delayed and poorly mineralised. The ends of the ribs are hazy and flared. Fractures affect the diaphyses, whose diameter is reduced, and the fracture risk is increased by bowing of the tibias when the child learns to stand [27].

**Treatment and outcome**

The treatment of fractures in neonates, infants, and toddlers relies on orthopaedic methods appropriate for the size of the child.

**Birth trauma**

In neonates, light immobilisation by bandages, a dressing over gauze pads, or a cast is used (Fig. 2b). A Pavlick harness or traction may be used to treat femoral fractures. Surgical treatment is never appropriate. Birth fractures heal consistently and very rapidly, within 2 weeks (Fig. 1b) [3–5].

**Diaphyseal fractures**

Accidental and non-accidental fractures that are not related to bone fragility are treated with casting or splinting depending on the stability of the fracture site. If the child is learning to walk, the restraints are designed to withstand the additional loads related to frequent falls. Detailed instructions about surveillance of the child are given to the parents. A home visit by a well-child clinic worker may be useful when difficulties related to the family's situation are anticipated or when the family has trouble understanding the instructions. Close clinical and radiographic monitoring is in order according to standard orthopaedic practice. The outcome is usually favourable, with immobilisation times of 3 to 4 weeks for metaphyseal fractures and 4 to 6 weeks for diaphyseal fractures. Malunion with angulation undergoes rapid correction. The growth spurt (Trueta effect) should be monitored during the first 18 months after the injury.

The management of fractures related to OI relies heavily on orthopaedic techniques in children younger than 18 months. Duration of the immobilisation should be as short as possible to avoid inducing osteoporosis related to limb immobility. Nevertheless, methods that deserve consideration in severe bowing of the long bones are telescopic nailing using the Fassier-Duval system or the stable elastic Metaizeau system for long bones and K-wires for short bones.

Figure 11 Healed birth fracture of the right femur and large-radius bowing of the left femur with an antero-lateral apex in a 7-month-old with type II osteogenesis imperfecta receiving bisphosphonate therapy.
Plate fixation must never be used given the high risk of fracturing at the edge of the material or upon material removal. Among pharmacological tools, bisphosphonate therapy has considerably improved the prognosis by slowing the pace of bone resorption. Beneficial effects include pain relief, a lower frequency of fractures, and improved stature and self-sufficiency in severe forms. Great care should be taken to ensure that the calcium and vitamin D intakes are sufficient throughout life.

In the other causes of bone fragility, aetiological treatment is given whenever possible. The treatment approach to the fractures is similar to that used in OI.

**Physeal injuries**

Physeal injuries deserve special attention given the classical risk of epiphyseolysis. This risk is higher in Salter-Harris types 3 and 4, which are exceedingly rare before 18 months of age. When there is little or no visibility of the ossification centre on the radiographs, reduction is only approximate. This has no adverse consequences, as bone remodelling is greatest near the growth plates. The occurrence of growth disturbances requires prolonged follow-up over many years.

**Conclusion**

Birth fractures are exceedingly rare and carry an excellent prognosis, despite their major emotional impact on the parents and obstetrician. The orthopaedic surgeon must deliver reassurance and ensure the appropriate treatment of the bone lesion.

Fractures before 18 months of age are far less common than in older children but are also far more likely to be cause by abuse. Therefore, the orthopaedic surgeon who provides care to the child and family must maintain a high level of alertness to the possibility of abuse. Physicians should comply scrupulously with the deontological and legal requirements designed to protect minors. An evaluation for evidence of a bone fragility syndrome is crucial.

Prolonged follow-up of the child is in order to detect any new lesions. Hospital discharge summaries sent to the usual family physician and any medico-legal reports must be drafted with care, and the appropriate descriptions must be entered into the child’s personal health record, which is the only document usually available each time the child is seen in France. By maintaining a high level of alertness, each healthcare worker or social worker involved in child care should be able to identify potential abuse, while limiting the risk of ascribing accidental fractures to other causes.

**Disclosure of interest**

The authors declare that they have no conflicts of interest concerning this article.

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**References**


Further reading

Additional information is available on the following web sites (all in French)

http://oned.gouv.fr/.
http://www.enfance-et-partage.org/.