


Fifteen-minute consultation: The toddler's fracture

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ABSTRACT

The toddler's fracture is a distinct entity among tibial shaft fractures. It is defined as a minimally displaced or undisplaced spiral fracture, usually affecting the distal shaft of the tibia, with an intact fibula. They are often difficult to diagnose due to the absence of witnessed trauma and because initial radiographs may appear normal. Moreover, the presenting complaint (a non-weight bearing child) has a wide differential diagnosis. A detailed history and examination, together with additional imaging and other investigations, is crucial to diagnose a toddler's fracture. Analgesia and immobilisation are the mainstays of treatment, with follow-up in fracture clinic recommended. Inflicted injury (Note: this article will use the term inflicted injury which is also called non-accidental injury. In the field of safeguarding, there is a move away from using the term 'non-accidental injury' due to misinterpretation of the term as being less serious than 'abusive injury' and that in child protection reports the term can be easily misread or mistyped as 'accidental' injury) should always be considered when red flags for child abuse are present. In this article, we aim to cover the differential diagnoses for toddler's fracture including indicators that might suggest an inflicted injury.

CASE SCENARIO

As the paediatric doctor covering the emergency department on a weekend night shift, you assess a 20-month-old boy, accompanied by his mother. He has reportedly been reluctant to walk since going to the park with his grandparents that afternoon. According to the mother, the grandparents did not witness any falls nor other accidents; the boy had been playing with his sister all afternoon, frequently going down the slide in the playground.

INTRODUCTION

The limping or non-weight bearing toddler is a common acute paediatric

presentation, which can cause significant concern for carers and clinicians alike. One common cause of limping is a toddler's fracture, defined as a minimally displaced or undisplaced spiral fracture, usually affecting the distal shaft of the tibia, with an intact fibula (see [figures 1 and 2](#)).¹ Toddler's fractures occur as a result of low energy trauma with a rotational component (twisting injury) and are named due to their occurrence in children between the age of 9 months and 3 years.² Occasionally, this type of injury can be sustained by older children.

The diagnosis of a toddler's fracture can be challenging at the time of presentation: there is often no definitive history of an injury (or the trauma is underestimated by carers), and the physical examination may elicit crying without a clear localisation of pain. Moreover, the differential diagnosis for limping in childhood is wide ([table 1](#)) and the radiological evidence may be subtle. The documented incidence of toddler's fractures among emergency paediatric presentations in the UK has been recorded at 2.5 in 1000 presentations.^{3 4}

One of the principal differential concerns, particularly in children under 1 year, is the possibility of inflicted injury. A recommendation for the investigation and management of possible inflicted injury is provided under the heading 'Safeguarding'.

In this article, we aim to provide a practical aid for the clinical assessment of the limping toddler, with a focus on the toddler's fracture.

HISTORY

A key clinical factor to clarify at the time of presentation is whether the limp is judged to be traumatic or atraumatic. However, this distinction has limitations, as there may be no witness to a traumatic cause, or alternatively a coincidental history of injury may be reported



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Figure 1 Plain X-ray AP view of toddler's fracture: a minimally displaced or undisplaced spiral fracture, usually affecting the distal shaft of the tibia, with an intact fibula. AP, anteroposterior.

in a non-traumatic condition. You should ask about the duration and progression of symptoms. As far as possible, it is important to establish whether pain is present and where this is located; however, this is frequently challenging for both carers and clinicians. Systemic symptoms such as fever, lethargy, stiffness, preceding illnesses (eg, a viral infection) and comorbidities (eg, cerebral palsy, sickle cell disease, malignancies) are important to identify. Previous child protection concerns, frequent previous minor injuries, previous serious injuries or delayed presentation should prompt the consideration of inflicted injury and must be documented in all cases. The impact of



Figure 2 Plain X-ray lateral view of toddler's fracture: a minimally displaced or undisplaced spiral fracture, usually affecting the distal shaft of the tibia, with an intact fibula.

the injury on social functioning (for both child and family) should also be discussed.

EXAMINATION

A full physical examination should be performed, including a detailed examination of the musculoskeletal system. The paediatric gait, arms, legs and spine (pGALS) examination is useful to identify focal tenderness, signs of deformity, warmth, swelling, redness or stiffness, in those old enough to follow instructions.⁵ The spine, especially, is an important part of the examination in the limping toddler. Clinically, a useful sign in the diagnosis of a toddler's fracture is the inability to weight bear. This feature is moderately sensitive (82%); however, it is not specific (30%) to the injury type.⁶ Localised bone tenderness is less diagnostic, with one clinical study reporting a limited sensitivity of 59% and specificity 53%.⁶

Pain scoring should be documented using an age-appropriate aid such as the FLACC (face, legs, activity, cry, consolability) scale or Wong-Baker Faces pain rating scale.

The general appearance of the legs and gait should be examined with bare legs. The legs should be inspected visually for bruising, deformity, scars and skin discolouration. Running can exaggerate a limp, which can be a helpful diagnostic test. An abnormal gait can be antalgic, where there is a shortening of the stance phase on the affected side. The child may not necessarily report any pain, if this is compensated for by limiting their stance phase. Other types of pathological non-antalgic gait are a steppage gait, Trendelenburg

Table 1 Differential diagnosis of a limp in a toddler^{8 13 14}

Category	Diagnoses	Key features in history and examination
Toddler's fracture		<ul style="list-style-type: none"> ▶ Trauma (twisting) ▶ Bone tenderness±deformity
Other traumatic fractures	Greenstick (bowing) fracture	<ul style="list-style-type: none"> ▶ Trauma ▶ Bone tenderness±deformity
	Buckle or transverse fractures	<ul style="list-style-type: none"> ▶ Trauma ▶ Bone tenderness±deformity
Pathological fractures	For example, neuromuscular, tumours (benign such as blastoma or malignant such as leukaemia or Ewing sarcoma)	<ul style="list-style-type: none"> ▶ Sudden onset limp in a child with a known background of neuromuscular problem or malignancy with bony tenderness±deformity and/or trauma ▶ Systemic symptoms: unwell/lethargy, B-symptoms (see under malignancy), possible petechial rash ▶ Waking from sleep due to pain
Other orthopaedic (chronic)	For example, DDH, congenital talipes	<ul style="list-style-type: none"> ▶ Known history of DDH or congenital talipes ▶ Ortolani or Barlow positive, clicky hip or leg length discrepancy ▶ Foot deformity
Other orthopaedic (acute)	For example, SUFE, vertebral fracture	<ul style="list-style-type: none"> ▶ Painful, restricted hip movements (especially internal rotation—SUFE) ▶ Vertebral tenderness with possible radiating pain ▶ Typically presents in boys aged 10–17 years and girls aged 8–15 years and is extremely rare in toddlers
Osteonecrosis (Perthes)	SCD	<ul style="list-style-type: none"> ▶ Known background of SCD ▶ Slow onset of limp with possible pain in groin or knee, ▶ Abnormal stance such as in toeing (if not recognised early) ▶ Typically present in 4–9 years
Infection	(Subacute) osteomyelitis	<ul style="list-style-type: none"> ▶ Gradually worsening pain ▶ Fever and being unwell ▶ Possible tenderness on palpation
	(Septic) arthritis	<ul style="list-style-type: none"> ▶ Acute limp ▶ Fever and being unwell ▶ Swelling/warmth/redness of joint ▶ Possible preceding illness ▶ Look for tick/insect bites, skin lesions and wounds
	Discitis	<ul style="list-style-type: none"> ▶ Back pain ▶ Fever ▶ Possible radiating pain
	Viral myositis	<ul style="list-style-type: none"> ▶ Preceding viral illness ▶ General malaise and muscle aches
Malignancy	Soft tissue infections	<ul style="list-style-type: none"> ▶ Local signs of infection
	Reactive arthritis (post-viral)	<ul style="list-style-type: none"> ▶ Preceding viral illness ▶ Absence of red flags
	For example, leukaemia or bone tumours	<ul style="list-style-type: none"> ▶ Unwell/lethargy ▶ B-symptoms (fever, night sweats, unintentional and unexplained weight loss) ▶ Possible signs secondary to thrombocytopenia, anaemia ▶ Gradually worsening pain ▶ Waking from sleep due to pain
Haematological	For example, haemarthrosis	<ul style="list-style-type: none"> ▶ History of thrombophilia ▶ Look for swelling of the joint
Autoimmune disorders	For example, rheumatological disorders, vasculitis	<ul style="list-style-type: none"> ▶ Positive family history ▶ Fever ▶ Pain and stiffness in the morning, pain improves with activity ▶ Gradually worsening pain ▶ Extra-articular symptoms such as conjunctivitis, rashes
Abdominal and inguinoscrotal pathology	Appendicitis, psoas abscess	<ul style="list-style-type: none"> ▶ Fever ▶ Abdominal pain
	Testicular torsion, inguinal hernia	<ul style="list-style-type: none"> ▶ Painful swelling in inguinal canal or scrotum ▶ Possible discoloration of skin
	Neuroblastoma	<ul style="list-style-type: none"> ▶ Abdominal pain ▶ Abdominal mass ▶ Raccoon eyes
Neuromuscular	For example, muscular dystrophy, cerebral palsy, myelomeningocele	<ul style="list-style-type: none"> ▶ Proximal lower limb weakness with Gower sign and normal neurology of lower limbs and calf hypertrophy (muscular dystrophy) ▶ Spasticity and hyper-reflexia

Continued

Table 1 Continued

Category	Diagnoses	Key features in history and examination
Others	For example, osteogenesis imperfecta, metabolic	<ul style="list-style-type: none"> ▶ Known history of metabolic disorder ▶ Previous fractures or family history
Inflicted/non-accidental injury		<ul style="list-style-type: none"> ▶ History of trauma that is not plausible, consistent or appropriate for injury sustained ▶ Other red flags such as: inappropriate interaction between child and accompanying carer, bruising in unusual places or with unusual shapes, multiple fractures in different stages of healing or unusual or typical fractures, genito-urinary trauma
Functional limp		<ul style="list-style-type: none"> ▶ Diagnosis of exclusion

DDH, developmental dysplasia of the hip ; SCD, sickle cell disease; SUFE, slipped upper femoral epiphysis.

gait, circumduction gait or equinus gait and should point to alternative diagnoses of a toddler's fracture.⁷

A neurological examination to identify weakness or ataxia, an abdominal (and if relevant genital) examination and an assessment for generalised lymphadenopathy should be performed as part of the physical assessment of the child. It is important to record any bruising or petechiae and to consider the pattern and number of bruises, which can indicate underlying causes such as idiopathic thrombocytopenic purpura, Henoch Schonlein purpura, leukaemia or inflicted injury. The presence of fever (or reported fever at home) should be documented, as this can determine the likelihood of alternative and more serious diagnoses such as septic arthritis and malignancies which should not be missed.

In the case of a (radiologically) proven fracture, it is important to ensure and document the presence of distal pulses and to be vigilant for pallor distal to the fracture or disproportionately severe pain as features of developing compartment syndrome. Table 1 gives an overview of the main differential diagnoses of a limp in a toddler age child.

INVESTIGATIONS

The optimal investigation(s) for a limping toddler will depend on the history and physical examination findings. If focal bone pathology is suspected, plain radiographs should be performed in two planes, usually anterior-posterior and lateral.⁸⁻¹⁰ In cases of a suspected toddler's fracture, the knee and ankle should be imaged along with the tibia and fibula to avoid missing peripheral injuries. It is important to be aware that in a small proportion of undisplaced fractures, the initial radiographs can appear normal.^{8 11}

When routine radiographs demonstrate no injury but a fracture is suspected, additional oblique views may help visualise the fracture line in a proportion of cases (4%–29%).^{9 11 12} Radiographic evidence may only become apparent 7–10 days after the initial injury when new periosteal bone formation ('callus') occurs. Another useful tip is to ensure you have performed imaging on the correct leg as sometimes parents can accidentally guide the clinician incorrectly. Moreover,

toddlers' gaits can sometimes be challenging to assess and need careful examination in mild limping. If radiographs are negative, further baseline investigations including a full blood count, erythrocyte sedimentation rate and C reactive protein should be considered, as well as bone profile and blood cultures if alternative aetiologies are suspected.¹³ A vitamin D level might also be considered. If initial tests are inconclusive or deemed unnecessary, specialist orthopaedic consultation and senior paediatrician involvement should be sought to determine the expected benefit and timing of further investigations. Additional imaging tests will vary according to clinical scenario, but may include ultrasound of the hip, MRI, a nuclear medicine bone scan or follow-up with repeat radiographs. Advice regarding the most appropriate radiological modality under consideration of radiation risks can be obtained from the local imaging department.

MANAGEMENT

Specific management will be guided by the suspected aetiology of the limp; however, all initial treatment should include simple analgesia. This is kinder to the toddler and it will help your examination. Pain score should be recorded preanalgesia and postanalgesia.

Box 1 Red flags for inflicted injury

- ▶ Injury inconsistent/not plausible with injury mechanism according to carer (eg, proximal lower limb fractures in non-mobile child).
- ▶ Abnormal carer-child interaction.
- ▶ Delayed presentation or other signs of neglect such as appearing unkempt, wearing inappropriate clothing for season, poor dental hygiene, untreated infestations.
- ▶ Frequent reattender with injuries.
- ▶ Previous safeguarding concerns/child known to social care.
- ▶ Metaphyseal corner fracture.
- ▶ Multiple fractures in different healing stages.
- ▶ Other abnormalities on physical examination such as bruising, marks with a clear shape of an object or sharply demarcated burns.
- ▶ Injury sustained during an incident of domestic abuse.

In a radiographically proven toddler's fracture, limb support should be offered with a backslab, cast or splint, which may be placed either above or below the knee for a duration of 3–4 weeks.^{3 14} A walking boot can be used as well.¹⁵ In cases with a strong suspicion of toddler's fracture lacking radiographical evidence at presentation, the same treatment should be considered.⁶ Immobilisation with a cast, however, is associated with a greater number of repeat X-rays and follow-up appointments and can cause skin breakdown.¹⁵ Studies have shown that presumed toddler's fractures without radiographic evidence are less likely to receive immobilising treatment and that the received

treatment varies among hospitals and countries.^{16 17} Some evidence suggests that there is no difference in recovery time between treatment of a toddler's fracture with or without immobilisation.¹⁵ To describe the management of alternative causes of limp is beyond the scope of this article, but this is covered in detail in other referenced articles.^{7 18}

REFERRALS, PROGNOSIS AND FOLLOW-UP

In the case of a radiographically proven toddler's fracture, the child should be followed up in a dedicated fracture clinic. It takes approximately 3–4 weeks for a toddler's fracture to heal.² In case of presumed toddler's fracture without radiographic evidence, repeat radiographs after 7–10 days can be used to confirm the diagnosis.¹⁴ However, clinicians should preferentially be guided by the clinical presentation rather than follow-up imaging alone.³ No significant difference in the time to discharge or complications has been demonstrated between proven and presumed toddler's fractures.³

Other causes of a non-weight bearing toddler may require different follow-up, depending on the underlying diagnosis. In the case of a suspected inflicted injury, the child must be put in a place of safety, which usually is the hospital, while awaiting further investigations such as a skeletal survey. As the treating clinician, you are responsible for escalating your concerns to a senior clinician and the named child safeguarding lead, as well as liaising with children's social care to ensure the ongoing safety of the child.

SAFEGUARDING

While any fracture in a child under 2 years of age warrants careful consideration for inflicted injury, undisplaced spiral fracture of the tibia without a concomitant fibular fracture is most likely to be an unintentional toddler fracture particularly if the child is a boy less than 2.5 years of age.^{19 20} Evidence from the RCPCH (Royal College of Paediatrics and Child Health) child protection systematic review on fractures demonstrates that metaphyseal fractures are particularly associated with a high risk of inflicted injury but they are more likely to occur in babies under 1 year of age and non-mobile infants.²¹ When other injuries or fractures are present that either have no explanation or an injury or fracture that does not fit with the explanation given, child abuse is more likely.¹⁹ Box 1 lists some of the red flags for inflicted injury.

SUMMARY

The limping or non-weight bearing toddler is a common acute paediatric presentation. Making the diagnosis of a toddler's fracture can be challenging at the initial evaluation, as there is often no definite history of injury, and examination might elicit crying without clear localisation of pain. Routine investigation should include plain radiographs, whereas other investigations should be

Test your knowledge

In the emergency department, you are seeing a 14-month-old Afro-Caribbean boy, with no previous medical problems, who is refusing to weight bear on his left leg. His father says he has had a fever for the past 24 hours.

Case 1

- Which sign on physical examination should worry you the most?
 - Blueish discoloration over the buttocks
 - A warm left knee
 - A splinter on the sole of the left foot
- What other information in the boy's history is important to elicit?
- Which initial blood tests would you do?

Case 2

You are being asked to see a 2-year-old girl who is brought in by her parents because she suddenly stopped walking. She has otherwise been well and parents have not noticed any fall nor stumbles. On examination, she seems well, with normal observations. Physical examination is normal besides a reluctance to weight bear on the left leg. You think there might be some tenderness over the left lower limb but she cries throughout the examination.

- Which investigation would you do?
- If the investigations confirm your diagnosis, how would you treat the child?

Case 3

A father brings his 10-month-old son to the emergency department because he is refusing to weight bear. Last weekend, the boy stayed at his mother's house as she takes care of him over the weekends. When he returned he was not pulling up to stand anymore. He has otherwise been well. On physical examination, you cannot elicit focal bony tenderness but the left lower leg is definitely more painful on movement with a noticeable reluctance to weight bear on the left leg. You also notice three round 1 cm bruises to his left upper arm and a 2 cm bruise to his left chest wall.

- What is the first investigation you do?
- What is the most important diagnosis to exclude?
- What type of radiographic features would be concerning?
- What is your management plan?

Answers to the quiz are at the end of the references.

guided by the suspicion for an alternative cause of the limp. Treatment of a presumed toddler's fracture is with analgesia and immobilisation in a plaster cast or similar. Ultimately, a toddler's fracture may be a *clinical diagnosis* in a young child where a fractured tibia is suspected clinically, but an abnormality is not detected on the initial radiograph. A toddler's fracture with or without explanation is less likely to be an inflicted injury but every fracture in a child under 2 needs careful consideration and should be evaluated in the wider context of the child and family.

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Answers to the quiz

Case 1

- Blueish discoloration over the buttocks would suggest Slate grey nevus (Mongolian Blue spot)
- A warm left knee would suggest early septic arthritis
- A splinter on the sole of the left foot would suggest foreign body

- It would be important to find out if he has sickle cell disease or, if recently arrived in the UK, whether there is a family history of sickle cell disease.
- Full blood count, erythrocyte sedimentation rate and C reactive protein, blood culture and screening for sickle cell disease if not born in the UK and not previously tested.

Case 2

- Anteroposterior and lateral X-rays of tibia and fibula including knee and ankle.
- Suspected diagnosis should be toddler's fracture; analgesia and immobilisation according to local protocol/advice.

Case 3

- Anteroposterior and lateral X-rays of tibia and fibula including knee and ankle.
- Inflicted injury.
- Multiple fractures in different healing stages, metaphyseal corner fracture.
- Analgesia, discussion with senior clinician, named safeguarding lead, social services and admission for additional investigations such as skeletal survey, ophthalmology review.