



## Posttraumatic cyst-like lesions of cortical bone in children

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Cyst-like cortical defects appearing after minor greenstick fractures in children have occasionally been described. These lesions are asymptomatic and appear just proximal to the fracture line within the area of subperiosteal new bone formation. Although the pathogenesis of these lesions remains conjectural, complete resolution occurs, without adverse effect on fracture healing. Only a few cases of these posttraumatic cysts have been previously reported, mainly in radiological literature. We present a case of cyst formation after a greenstick fracture of the distal radius. We discuss the evolution of these post fracture cysts and review the current theories on their pathogenesis.

**Keywords :** cyst-like lesions ; post-fracture ; children.

### INTRODUCTION

Posttraumatic cyst-like lesions after fractures in children have been reported only rarely in orthopaedic literature. These lesions typically present as incidental findings on follow-up radiographs and do not appear to influence fracture healing.

The cystlike lesions usually appear a few weeks after the fracture and will eventually completely resolve. No treatment is generally indicated and there have been no reports of pathologic fracture through such a lesion (1).

We report a case observed at our institution and discuss the evolution of these post fracture cysts with a review of the current theories on their pathogenesis.

### CASE REPORT

An otherwise healthy 11-year-old girl fell onto her outstretched right hand, sustaining a closed injury to the distal forearm. She complained of pain in the distal part of her right forearm. She also had pain on compression and the range of motion in her right wrist was impaired. Radiographs revealed a greenstick fracture of the distal radius (fig 1).

Treatment consisted of a below-elbow plaster cast which was removed after 4 weeks. Radiographs 2 months after trauma showed healing of the fracture and the appearance of a round lucency, 8 mm in diameter, without peripheral condensation at the level of the distal radius within the newly formed periosteal bone, proximal to the site of fracture (fig 2). The patient did not have any complaints.

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**Fig. 1.** — Radiographs of the right wrist at the time of injury show a greenstick fracture of the distal radius. A : The AP view demonstrates no displacement. B : Lateral view shows a ventral angulation at the fracture site.



**Fig. 2.** — Radiographs of the right wrist two months after injury. A : AP view shows a small cystic lesion without peripheral condensation in the metaphysis of the distal radius. The cyst is non-expansive. B : The lateral view depicts the cortical break of the previous fracture and the radiolucent lesion within the ossified subperiosteal haematoma at the distal radius.

MRI made two and a half months after the injury demonstrated a healed greenstick impaction fracture of the right distal radius and extensive medullary oedema at the distal metaphysis of the radius. Furthermore anterior periosteal reaction with

a subperiosteal cyst was depicted (fig 3 & 4). The patient and her parents were reassured and no further treatment was proposed.

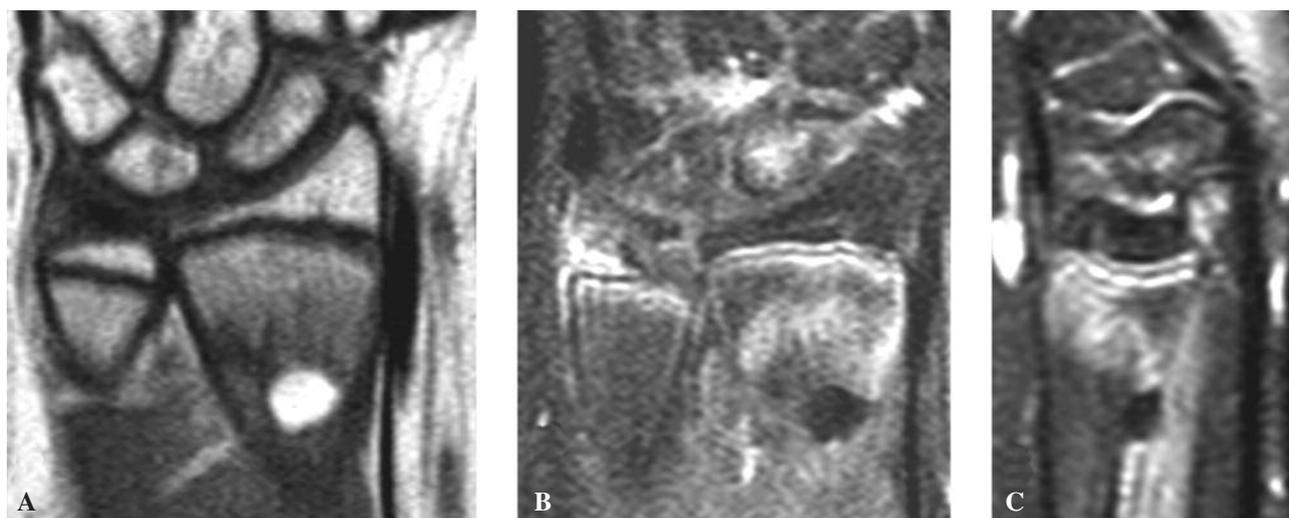
## DISCUSSION

Fractures that do not completely penetrate the entire bone shaft are not infrequent in children. A “greenstick” fracture is one that perforates one cortex and ramifies within the medullary bone and is usually the result of angular forces. In the healing stage of these fractures, well-defined subperiosteal defects have been observed but have only rarely been reported in the orthopaedic literature.

The first article about postfracture subperiosteal cyst-like defects was written by Levine *et al* in 1969. They reported on a postfracture cyst of the fibula in a 13-year-old boy. Initial radiographs revealed the fracture but there was no cyst formation. Four months later, a cystic swelling was present at the site of the fibular fracture. Eight months after the injury, the cystic lesion had continued to asymmetrically expand, with thinning of the adjacent bone. No other bone lesions were seen on skeletal survey. The lesion was interpreted as an aneurysmal bone cyst. At operation, an ovoid cystic mass was encountered that was filled with dark blood and fresh clots. The pathologic diagnosis was subperiosteal haematoma (6).

Caffey *et al* in 1978 were probably first to describe the more typical nonexpansile cyst-like lesions seen after fracture in children. They reported a case in a 9-year-old girl 20 weeks after a fracture of the distal radius. When explored surgically, the lesion was found to be filled with blood and a few multinucleated giant cells surrounded by cancellous bone (2).

Pfister-Goedeke *et al* reported in 1981 the largest series of cyst-like cortical defects after fractures in children. They reported on cyst-like cortical defects appearing a few weeks after greenstick fracture of the distal radius in nine children. All lesions were located proximal to the fracture line within the zone of periosteal reaction, and in all cases fracture healing was unaffected (11).



**Fig. 3.** — MRI two and a half months after injury.

**A :** Coronal MR image demonstrates a round lesion with homogeneous high signal intensity on T1 (and no trabeculation) corresponding to fat. The lesion is located at the proximal end of the fracture line. The signal intensity of the surrounding fatty marrow is slightly decreased due to oedematous infiltration.

**B & C :** The “fat-containing” round lesion has a decreased signal intensity on coronal (A) and sagittal (B) fat-saturated images (as expected when signal of fat is saturated). The surrounding medullary bone has an increased signal due to oedema.

Our case of posttraumatic cyst is typical, similar to the lesions reported by Pfister *et al* and a small number of other cases reported in literature (1-14).

These lesions are found in the cortex of the distal radius, about 2-4 months after a minor greenstick fracture. They are usually located just proximal to the fracture site within the area of periosteal reaction. They appear to cause no clinical symptoms, do not influence the fracture healing and are not associated with pathologic fractures. In those that have been followed radiographically, the lesions appear to resolve spontaneously. These lesions are usually found incidentally at routine follow-up examination or after reinjury of the same limb. The age of reported patients ranged from 2.5 to 15 years.

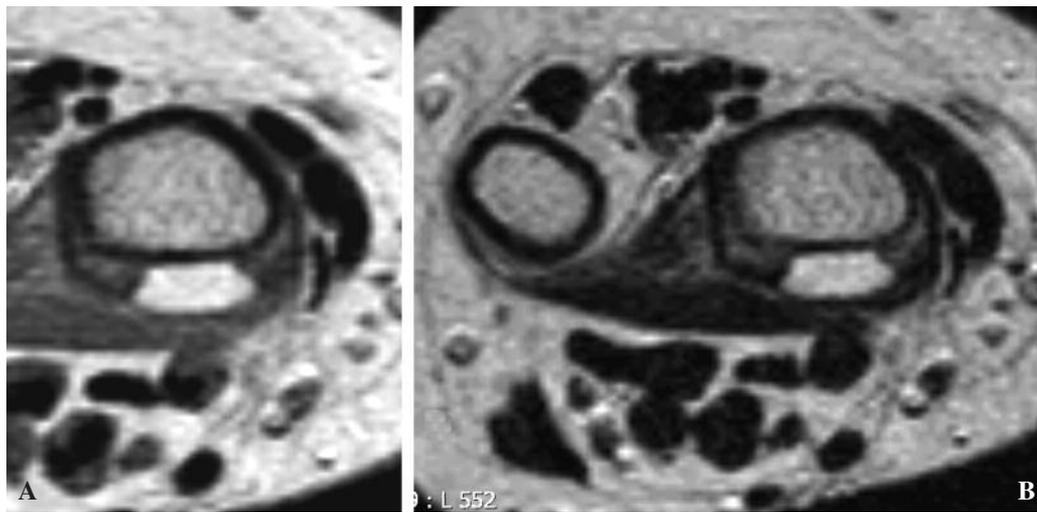
Previous reports have divided postfracture lesions into two groups : transient cortical defects seen only in children, of which our case is typical, and central expanding lesions found in both adults and children. Of the expansile cysts that have been reported to develop after a fracture, the majority were found on biopsy to be aneurysmal bone cysts. Other expansile lesions described include giant cell tumours, unicameral bone cysts and a pseudo-

aneurysm of the anterior tibial artery. Such expansile postfracture cyst-like lesions are extremely rare. The natural history of these lesions is distinct from the more typical postfracture cysts seen in children. The expansile lesions usually respond to treatment with curettage and bone grafting.

The transient cyst-like cortical defects seen in children after a minor greenstick fracture represent an entirely different entity. These lesions resolve without any treatment. Failure to recognize this condition can lead to extensive diagnostic evaluation and create unnecessary apprehension for the patient and family.

The literature is controversial regarding aetiology of the more typical transient post-fracture cyst-like lesions.

Biopsy had never been clinically justifiable, but several suggestions have been made. Pfister-Goedeke *et al* believed them to be resorption cysts within the excessive periosteal reaction commonly seen with greenstick fractures (11). Philips *et al* attributed the lesions to intraosseous haemorrhage and its later resorption (12).



**Fig. 4.** — A : Axial MR proton density and B : T2-weighted images disclose the intra-cortical location of the lesion within the thickened anterior cortex.

The study of Malghem and Maldague demonstrated a fatty content of these lesions on CT and suggested that they could be the result of inclusion of intramedullary fat within the subperiosteal haematomas. They thought that such an interpretation would account for the time lag before their appearance and the absence of growth once they had appeared. They stated that fat within the subperiosteal space could only become evident on standard radiographs once the surrounding haematoma was becoming calcified after a few weeks (7).

Moore *et al* believed it would be very unlikely that sufficient intramedullary fat would be present in the usual age group encountered to cast such an image, stating that anatomical studies have shown that only red marrow is present in the radial shaft in children younger than 12 years of age (9).

Another article of Malghem *et al* outlined that the conversion from red to yellow marrow was progressive and that the fat drops may be derived from red marrow. In support they showed the CT density of fat in the medullary cavity of the shafts in two additional cases (8).

Dürr *et al* used magnetic resonance imaging in their case report to demonstrate fat within the cystic lesion of their patient. They supported the theory of transcortical escape of intramedullary fat into the subperiosteal haematoma (4).

Ball *et al* support this theory. Provided that the intramedullary injury liberates fat and there is cortical disruption with periosteal elevation without disruption, the fat that leaks out could become trapped within the subperiosteal haematoma. The fat that leaks out subsequently becomes visible as a cystic lesion as the subperiosteal haematoma becomes resorbed (1).

Overall there is no absolute evidence for the aetiology of these cyst-like lesions, but the “fat inclusion theory” is supported in multiple studies. This was also supported in our study, which demonstrated fat inclusion by MRI.

There is still uncertainty as to why these post-traumatic cyst-like lesions are so rarely reported, given that greenstick fractures are so common in children. A possible reason is that these fractures are seldom followed radiographically past the point of clinical union, which is usually before these cyst-like lesions can be visualized on radiographs. These lesions will therefore not be seen unless the patient reinjures the same limb or is seen in a longer term follow-up. Malghem *et al* believed that the fracture itself is also an important factor. It needed to be of sufficient severity to produce a cortical breach large enough to allow extrusion of bone marrow fat, but moderate enough to leave the periosteum intact. If the periosteum is torn, the medullary fat

can indeed easily diffuse into the surrounding tissues (7,8).

When a posttraumatic cyst-like lesion is discovered in a child after a greenstick fracture, this can be clinically confusing. The differential diagnosis should include osteomyelitis, post-traumatic intraosseous ganglion, a cortical cystic defect in neurofibromatosis and different posttraumatic expanding cystic processes like aneurysmal bone cyst, giant cell tumour and haematic cyst.

It is therefore important to perform a thorough history, clinical examination and to carefully review the presenting radiographs to rule out the possibility of an unrecognized pre-existing lesion and pathologic fracture. Screening blood tests can also assist to rule out the possibility of infection or inflammation.

Usually, however, the radiographic appearance of a healing greenstick fracture with cyst-like lesion is very characteristic and is not to be confused. These lesions have no clinical consequence, but correct identification is required to prevent unjustified investigations.

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