CASE REPORT

Salter-Harris II forearm fracture reduction and fixation using a buttress plate

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SUMMARY

Distal radius fractures are common injuries in children. Those that affect the growth plate (physis) need to be managed carefully as inadequate management may lead to long-term deformity and a reduction in function. However, different management strategies all have drawbacks and controversy exists over how best to manage these cases. This is the case of a 13-year-old girl who presented with a Salter Harris II fracture, which was managed using a novel approach of utilising a T plate in a buttress mode to stabilise the fracture after anatomical reduction. This provided effective fracture fixation and should allow good bone healing without causing any iatrogenic growth plate damage and without fixing a plate across the physis, which may need removal in the future.

BACKGROUND

Distal radius fractures are common injuries¹ and are one of the commonest paediatric orthopaedic injuries^{2–3}—the incidence in the skeletally immature patient is estimated to be between 400 and 10 000/100 000.² They most commonly occur from a fall onto an outstretched hand.^{4–5}

Unlike in adults, distal radius fractures in children often heal quickly and accurately.⁵ However, complete remodelling is not guaranteed,³ with poor bone remodelling most likely to occur in children over 10 years.^{3–6}

Poor bone remodelling can lead to malunion and deformity with associated cosmetic and functional impairment. This may necessitate future surgical intervention,^{5–7–8} growth arrest,⁹ reduction in grip strength⁵ and reduced range of movement.⁷ Any of these potential sequelae, in isolation or in combination, may result in long-term pain and stiffness and/or disability.

The degree and efficiency of remodelling depends on a number of factors including metabolic factors, fracture location, the degree of deformity and the plane of deformity. To achieve good bone healing, the biochemical regulators of bone homeostasis must be working effectively. These include the mechanisms that control calcium, vitamin D, parathyroid hormone and cytokines.^{10–11}

However, in the otherwise fit and well individual, bone healing abnormalities are more often due to abnormal forces being placed on the bone.^{3–12} Effective remodelling will occur only in the plane of motion—meaning that apex volar or dorsal angulation should remodel well, apex ulna or radial angulation should remodel, but may not remodel

completely, and rotational displacement may not remodel at all.¹³

Another key consideration in paediatric fracture healing is the growth plate (physis). This is the point where the bone grows from and damage to it, or to the metaphysis, can lead to physeal arrest and failure of further bone growth—or even paradoxical overgrowth.^{9–14} For this reason, effective fracture management is particularly important when the physis or metaphysis is involved.

The Salter-Harris classification allows classification of paediatric long bone fractures based on whether, and to what extent, they involve the metaphysis and physis. This is important for prognostication and for guiding management. The Salter-Harris classification is listed below with type 1 being the least likely to result in growth disturbance and long term disability and deformity and type 5 being the most likely.

- ▶ Type 1: A transverse fracture through the physis.
- ▶ Type 2: A fracture that traverses through the metaphysis and physis (most common).
- ▶ Type 3: A fracture through the physis, extending down and splitting the epiphysis, becoming intra-articular.
- ▶ Type 4: A fracture through the metaphysis, physis and epiphysis.
- ▶ Type 5: Compression fracture to the physis.

The basic principles of distal forearm fractures are the same as all other fractures; reduction, stabilisation and effective rehabilitation. Paediatric forearm fractures are most commonly managed conservatively.³ However, any fracture involving the physis should be anatomically reduced to ensure good alignment¹⁵ and reduce the risk of growth disturbance.

However, after reduction, the best method of fixation of such fractures is not clear and there remains a 'wide variation' in practice.⁸ There is, however, some evidence that plate fixation may lead to better outcomes than wire fixation.^{8–16} Despite this, plate fixation can still have complications (eg, soft tissue irritation and/or need for plate removal¹⁷). Wires cross the physis and can therefore lead to further trauma and possible growth disruption; however, plate fixation with distal and proximal screws could disrupt growth on the side the plate is placed. Furthermore, any foreign object, which itself disrupts the physis, has the potential to further inhibit effective bone remodelling.

CASE PRESENTATION

A normally fit and well 13-year-old school girl fell from her push-bike and landed on her outstretched

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Figure 1 Anteroposterior (A) and lateral (B) radiographs of the injury at presentation.

left hand. Her parents took her to the emergency department at the local district general. Plain radiographs showed a distal radius fracture. She was placed in a backslab and transferred to the regional paediatric orthopaedic trauma centre.

On arrival, clinical examination revealed a painful, swollen and deformed left wrist. There was no disruption of the neurovascular supply to the hand and no other injuries were present.

INVESTIGATIONS

After clinical evaluation repeat plain radiographs were taken. These showed a displaced Salter-Harris II fracture of her left distal radius. There was an associated distal ulnar fracture with volar displacement (figure 1; AO classification 23-A2).

TREATMENT

Owing to the displaced fracture configuration involving the immature growth plate, anatomical reduction was required and the patient underwent surgery. A standard surgical approach through the bed of flexor carpi radialis was followed with an elevation of pronator quadratus, allowing visualisation of the fracture. The periosteum was intact and indirect reduction was performed using a small fragment T Plate, in a buttress mode. Distal screws were not used. Intraoperative imaging revealed anatomical reduction and a stable fracture in extension/flexion and in pronosupination (figure 2).

Figure 2 Intraoperative imaging after fixation. Anteroposterior (A) and lateral views in flexion (B) and extension (C).

Figure 3 Anteroposterior (A) and lateral (B) radiographs 10 days after open reduction and internal fixation of the fracture.

OUTCOME AND FOLLOW-UP

The patient was discharged the following day in a backslab and high arm sling with routine postoperative instructions.

Serial fracture clinic review, with radiographs on arrival, showed that fracture reduction had been maintained and a new lightweight cast was applied (figure 3). There were no postoperative complications and she returned to full sporting activities.

DISCUSSION

This injury is not uncommon. However, it was one of the less common forms of paediatric forearm fracture as it involved the physis (Salter Harris II). Because of this it needed anatomical reduction to reduce the risk of future deformity and/or disability.

Controversy exists regarding how best these fractures should be stabilised once reduced. In this case, an approach of using a T plate in a buttress mode was used. This was possible because of the metaphyseal portion being reasonably large and on the volar aspect. This allowed good reduction of the fracture without having to disturb either the metaphysis or physis with wires or screws. This approach allowed good reduction and fixation, facilitating adequate bone healing, without stimulating excessive growth by introducing any metalwork into the distal metaphysis or physis. Furthermore, because the plate does not cross the physis it does not need to be removed, another potential complication of internal fixation.

This approach to fixation of this important fracture type not only provides excellent cosmetic and functional outcomes but also another potential option in the management of paediatric distal radius fractures.

Learning points

- ▶ Paediatric forearm fractures are common injuries, which can have significant sequelae if they involve the growth plate.
- ▶ The Salter-Harris classification of these fractures can inform management strategies and prognosis.
- ▶ Fractures in and around the growth plate need anatomical reduction to ensure adequate healing and to reduce the risk of altered growth.
- ▶ Controversy exists over how this can best be achieved, but using a T plate in a buttress mode may provide an elegant and safe option in some patients.

Contributors PF was the consultant responsible for the patient's care. MW was his registrar and JB was his house officer. JB and MW reviewed the notes and prepared the case report in conjunction with PF reviewing and editing it.

Competing interests None.

Patient consent Obtained.

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