

Galeazzi-Equivalent Fracture in Children Associated with Tendon Entrapment—Report of Two Cases

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Abstract

Introduction: This is a report of 2 consecutive cases of the Galeazzi-equivalent fracture in children. **Clinical Picture:** In both cases, the mechanism of injury was falls onto the outstretched hand. Radiographs showed fracture of the radius with separation of the distal ulnar physis. **Treatment:** Initial treatment by closed manipulation failed; hence, open reduction and internal fixation was required. The cause of failure of closed manipulation in both cases was interposition of soft tissue into the ulnar fracture site. **Outcome:** Both cases showed good functional outcome after open reduction and internal fixation. **Conclusion:** Recognition of this form of injury is necessary to ensure proper treatment is undertaken to prevent the complications of inadequate reduction and growth retardation.

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Key words: Internal fixation, Open reduction, Salter-Harris fracture

Case Reports

Case 1

A 12-year-old boy fell whilst running. On examination, there was swelling and deformity of the wrist and there was local tenderness of the distal third of the radius and the distal end of the distal ulna. Movement of all the fingers and thumb were limited by pain. Peripheral circulation was normal and there was no evidence of nerve injury.

Plain radiographs performed showed a greenstick fracture of the distal radius and a Salter-Harris Type II fracture separation of the distal ulna (Fig. 1). Initial treatment consisted of manipulation under general anaesthesia and immobilisation with a dorsal backslab. Postoperatively, the position of the reduction was shown to be acceptable on plain radiography with a dorsal backslab (Fig. 2). However, the patient's little finger was partially flexed and could not extend fully when he was reviewed the next day. The fracture was explored under general anaesthesia on the same day and the flexor digitorum profundus of the little finger was found to be trapped in the ulnar physeal fracture site, preventing accurate reduction of the fracture. Upon freeing the tendon from the fracture site, the fracture was easily and accurately reduced. Four Kirschner wires were used to hold the reduction in place (Fig. 3). The wires were removed after 4 weeks.

At 12 months post-injury, clinical examination of the patient revealed that the movements of the wrist were full. There was no resultant bone deformity or growth disturbance so far.

Case 2

A 14-year-old boy fell whilst playing basketball. He landed onto the dorsum of his right hand with the wrist joint in flexion. Plain radiographs showed a greenstick fracture of the distal radius with a Salter-Harris Type II fracture of the distal ulna (Fig. 4). The ulna physis was displaced volarwards.

Closed reduction was attempted to reduce the distal ulna epiphyseal fracture. However, this was unsuccessful and open reduction and internal fixation was performed at the same sitting. The extensor carpi ulnaris tendon and its sheath were found to have displaced volarwards, thereby preventing accurate reduction. After returning the extensor carpi ulnaris to its anatomical position, successful reduction was achieved. A 3.5-mm four-hole T-plate was applied to the distal radius followed by manipulation of the distal ulna epiphysis under direct vision. Intraoperative fluoroscopic imaging showed accurate reduction and the forearm was immobilised with an above elbow cast (Fig. 5). At 5 months follow-up, there was full range of motion of the wrist joint and fingers with no loss of sensory function of the hand.

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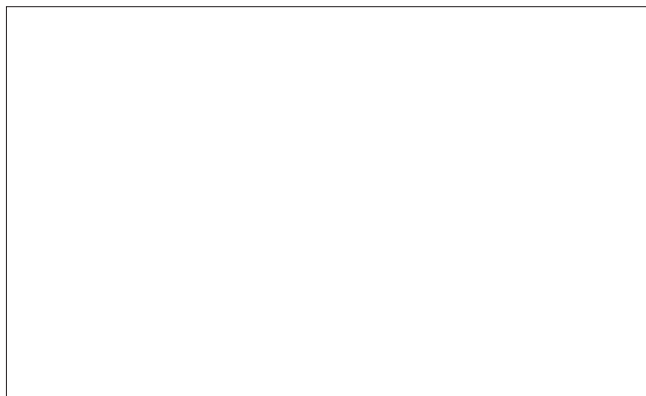


Fig. 1. Radiograph of Case 1 showing a fracture of the distal radius with physeal separation (Type II Salter-Harris fracture) of the distal ulna.

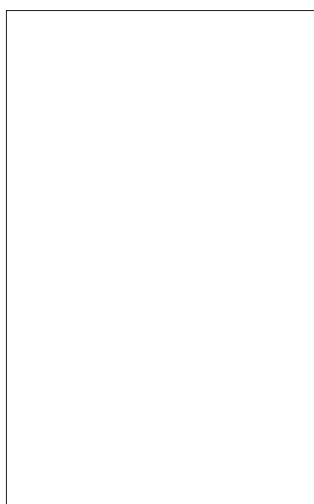


Fig. 3. Radiographs of Case 1 showing the results following open reduction and stabilisation of the fractures with Kirschner wires.

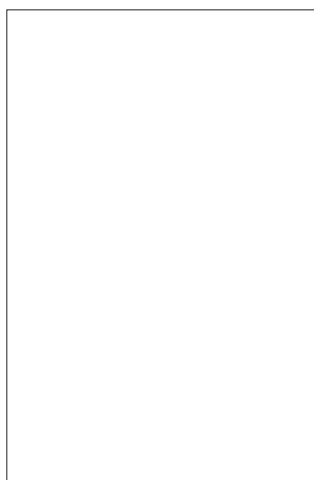


Fig. 5. Immediate postoperative radiographs of Case 2 after fixation with a 4-hole T-plate.

Plain radiographs performed showed fracture union (Fig. 6). The implant was removed 11 months after the initial operation. At the last clinic review 14 months after the injury, there was no loss of wrist function, though some

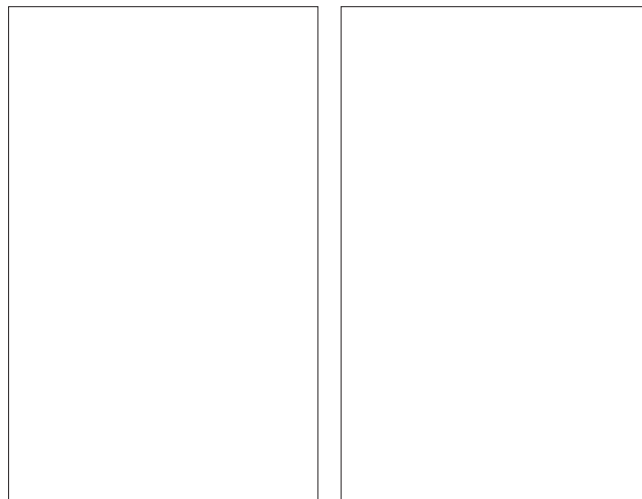


Fig. 2. Radiographs of Case 1 showing the post-reduction results after close manipulation of the fractures.

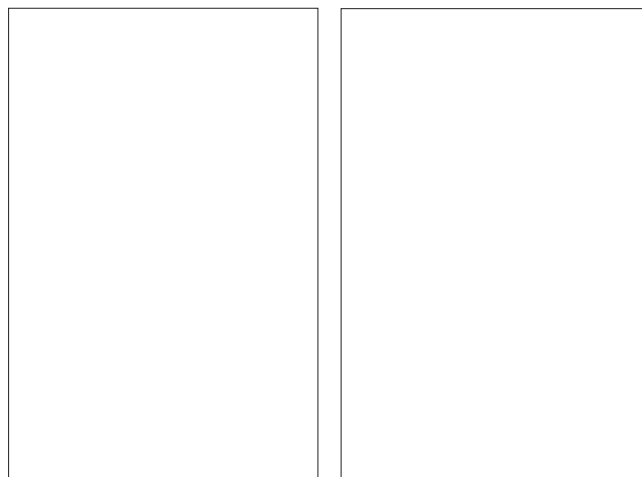


Fig. 4. Radiographs of Case 2 showing a fracture of the distal radius with a Type II Salter-Harris fracture of the distal ulna.

degree of growth retardation of the ulna can be seen on the plain radiograph (Fig. 7). The patient is still under follow-up.

Discussion

The Galeazzi fracture, which is a fracture of the shaft of the radius with an associated dislocation of the distal radioulnar joint, was first described by Astley Cooper in 1826.¹ However, it assumed the eponym from Riccardo Galeazzi in 1934.² This injury is mainly seen in adults but more rare in children.^{3,4} Apart from the classic Galeazzi fracture, there is the Galeazzi-equivalent fracture that occurs in children. This is a fracture of the distal radius with an associated fracture of the distal ulnar growth plate instead of the usual dislocation of the distal radioulnar joint. The pathological anatomy of these two entities is dissimilar.³⁻⁶ In the classic Galeazzi fracture, dislocation of the distal radioulnar joint occurs as a result of rupture to the distal

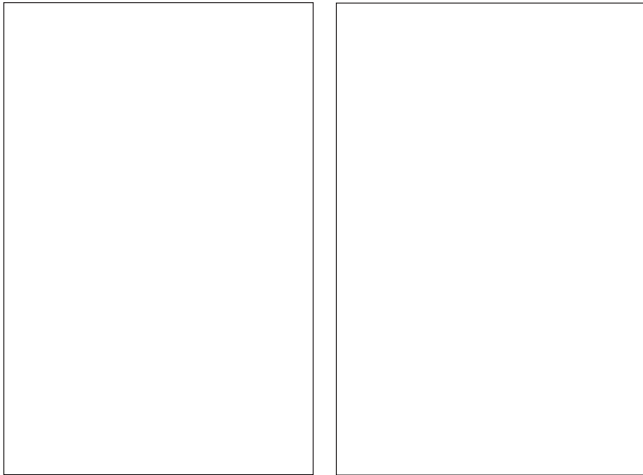


Fig. 6. Radiographs of Case 2 showing fracture union 5 months after fixation.

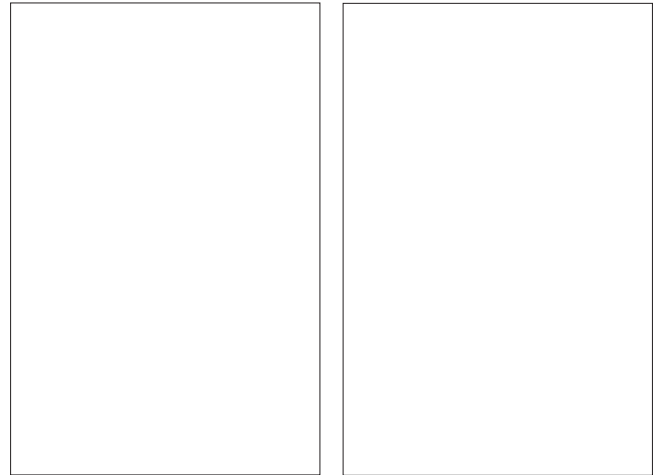


Fig. 7. Radiographs of Case 2 showing ulna growth retardation 14 months after fixation.

ligamentous stabilising system (DLSS) between the radius and the ulna. The DLSS consists of the triangular fibrocartilage complex, interosseous ligaments and the periosteal tube of the ulna. The integrity of the DLSS is maintained largely by the triangular fibrocartilage complex. However, in the Galeazzi-equivalent injury, the DLSS does not rupture but there is separation of the distal ulnar epiphysis. This probably occurs because the DLSS is mechanically stronger than the distal ulnar epiphysis, resulting in epiphyseal separation rather than a radioulnar dislocation.

The mechanism of injury is probably the same in both the Galeazzi and Galeazzi-equivalent fracture. It involves a fall onto the outstretched hand combined with extreme pronation or supination of the forearm.

It is evident that the Galeazzi-equivalent fracture is closely related to the patient's age. The ulnar epiphysis ossifies between the ages of 5½ and 9½ years in boys, and 4½ and 7 years in girls.⁴ Physiologic epiphyseal fusion is complete between ages of 14 and 20 years. Therefore in children with open physis, the distal ulnar epiphysis is more vulnerable to separation rather than the rupture of the triangular fibrocartilage complex as it offers less resistance than the latter.

However, our cases revealed a more peculiar presentation of this rare injury. Both cases featured excursion of soft tissue into the ulna fracture site. In Case 1, the flexor digitorum profundus tendon of the little finger was displaced dorsally and was caught in the epiphyseal separation, thereby preventing full extension of the little finger although reduction was satisfactory. In Case 2, the extensor carpi ulnaris had subluxed volarwards to the volar aspect of the forearm. Only after the replacement of the extensor carpi ulnaris to its anatomical position was reduction possible.

It is also interesting that these 2 cases occurred

consecutively. A detailed search of emergency medical and operative records between January 1994 and December 1997 revealed that there were no other cases of Galeazzi-equivalent fractures in children with or without soft tissue interposition. During this period, a total of 282 radial fractures in children between the ages of 4 and 16 were managed in our institution.

The authors would like to suggest that this injury is more likely to have soft tissue interposition than previously believed. In this respect, both our cases had tendon entrapment causing interposition. Landfried⁴ in 1991 reported 3 cases of this injury which required open reduction and the soft tissue caught at the fracture site was periosteum in 2 cases and periosteum and extensor carpi ulnaris in 1 patient. All 3 patients have full function of their wrist following open surgery. Imantani et al⁶ reported 1 case of this injury and open fixation was needed as the periosteum prevented reduction. The final outcome was excellent with maximal function of the wrist.

Letts and Rowhani,⁵ who have the largest series of this type of injury, operated on only 1 case. The overall results (Table I) while satisfactory, are inferior to the other reports mentioned thus far with 5 out of 7 patients having residual limitation of movement. In fact, 4 of the 6 treated by closed reduction had limited supination of 10° to 20° on follow up. This could suggest failure of reduction due to soft tissue interposition which only manifests after attempts at closed reduction.

Treatment options are varied. Closed reduction in children can lead to a good to normal outcome and should be attempted as a first-line treatment.⁵ Letts and Rowhani⁵ have provided a review of 6 children who underwent closed reduction for the Galeazzi-equivalent fracture. They found that loss of supination was the most common finding after reduction. Letts and Rowhani advocate the use of an

TABLE I: SUMMARY OF RESULTS FROM VARIOUS AUTHORS' SERIES

Report	Age/Sex	Type of accident	Reduction (radius/ulna)	Internal fixation (radius/ulna)	Result
Reckling (1982)	?	?	OR (ECU)*	None/None	Good
	?	?	CR	None/None	Good
	?	?	CR	None/None	Good
	?	?	CR	None/None	Good
Landfried et al (1991)	13/Male	Motorcycle accident	OR (periosteum and ECU)	Plate/None	Normal
	11/Male	Fell	OR (periosteum)	Plate/K-wire	Normal
	15/Male	Fell while skateboarding	OR (periosteum)	Plate/None	Normal
Letts et al (1993)	13	Fell on wrist	OR (ECU)	None/None	Limited extension 20°
	9	Fell while roller skating	None/None	None/None	Limited supination 20°
	13	Struck during hockey	CR	None/None	Normal
	12	Fell off bike	CR	None/None	Limited supination 10°
	13	Fell from height	CR	None/None	Normal
	10	Fell from height	CR	None/None	Limited supination 10°
	14	Fell off bike	CR	None/None	Limited supination 10°
Imatani et al (1996)	16/Male	Motorcycle accident	OR (periosteum)	None/K-wire	Normal
Ooi et al (2001)	12/Male	Fell	OR (FDP of little finger)	K-wire/K-wire	Normal
	14/Male	Fell during basketball	OR (ECU)	Plate/None	Normal

* interposed tissue in brackets

CR: closed reduction; ECU: extensor carpi ulnaris; FDP: flexor digitorum profundus; OR: open reduction

above-elbow cast with the forearm in full supination. This keeps the pronator quadratus taut, preventing it from rotating the radius in a volar direction and the ulna drifting dorsally. This will maintain the distal alignment of the radius and ulna.

If closed reduction fails, then the surgeon should assume that there is soft tissue interposed in the fracture site. About half will require open reduction and internal fixation of the radius (Table I). The common reason for failure of conservative treatment is the interposition of soft tissue in the fracture site itself as described in the case reports of Landfried et al⁴ and Imantani et al.⁶

The authors found a similar problem in both the cases reported. They feel that tendon or periosteum entrapment at the epiphyseal separation of the distal ulna occurs more commonly than previously believed. They recommend that open surgical treatment should be performed if closed reduction does not achieve perfect reduction, since this is usually due to soft tissue entrapment in the epiphyseal separation.

Perhaps the most important issue with the Galeazzi-equivalent fracture is the separation of the ulnar physis. Recognition of this injury and successful reduction is of paramount importance to prevent growth plate disturbance. The possibility that soft tissue may be interposed in the ulnar physeal fracture site cannot be over-emphasised. Therefore when open reduction is necessary accurate and stable reduction should be achieved. For the radius, Henry's approach is used and the radius is stabilised with a plate

after accurate reduction. Fixation can also be easily achieved with 2 smooth K-wires which will provide sufficient stability in most cases as the periosteum is usually at least partially intact.

Conclusion

The Galeazzi-equivalent fracture in children is rare and subtle. Therefore one may interpret it as a simple fracture of the radius. However, soft tissue interposition of periosteum and tendons is possible and occurs fairly frequently. Unrecognised soft tissue interposition results in imperfect reduction leading to loss of function and possible growth arrest at the physeal plate. Therefore, open surgical treatment is recommended if closed reduction is imperfect or in doubt.

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