This had been by a paratendinous incision in 65 fractures and a patellar-tendon-splitting incision in 36. The position of the nail in relation to the tibial plateau and anterior cortex was measured on postoperative lateral radiographs. The patients were reviewed to discover the incidence of knee pain and the need for nail removal.

Results. Sixty-one of the 107 patients (56%) developed troublesome knee pain in the area of nail insertion. When a paratendinous insertion had been used 33 of 65 fractures (51%) were associated with subsequent knee pain. When nail insertion was through the tendon 28 of 36 knees (78%) developed subsequent pain. This difference was significant (chi-squared test with Yates' correction, p < 0.01). There was no significant difference between the two groups in the mean distance of the nail from the plateau or the extent of nail protrusion beyond the anterior tibial cortex.

In 49 patients (46%) the pain was troublesome enough to require removal of the nail. At a mean of 16 months after removal, pain was completely relieved in 22 patients. Seventeen had only partial relief, and the remaining ten had no improvement. The pain relief after nail removal was not related to the entry point (Mann-Whitney test, p = 0.36).

Discussion. Tibial nailing has been associated with excellent results in most reports but there has been some concern about knee pain. In our series this was the most common complication, and the response to nail removal was unpredictable; only 45% of the patients had complete relief. Nail position in relation to the anterior cortex and tibial plateau had no influence on knee pain. We took particular care to avoid excessive prominence of the nail at the entry site; this may explain this lack of influence.

The use of a patellar-tendon-splitting approach for nail insertion was associated with a much higher risk of subsequent pain and our findings suggest that a paratendinous approach helps to reduce this. We now avoid splitting the patellar tendon for the insertion of tibial nails.

No benefits in any form have been received or will be received from a commercial party related directly or indirectly to the subject of this article.

REFERENCES


COMPLETE ULNAR NERVE DIVISION IN A DISPLACED SUPRACONDYLAR FRACTURE: A CASE REPORT

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Neurovascular complications of supracondylar fractures of the distal humerus in children are well described, but to our knowledge ulnar neuritis has not been reported in association with closed injuries of this type.

Case report. A ten-year-old girl presented after a fall. She complained of pain in the elbow and numbness in the little and ring fingers of the hand. She had obvious swelling of the elbow, with tenderness and limitation of movements. There was complete anaesthesia to light touch and pinprick in the ulnar one-and-a-half digits of the left hand and no power in the interossei. The little and ring fingers had a clawed posture. There were no abnormalities in the distribution of the median or radial nerves and the radial pulse and capillary return showed adequate distal circulation. Radiographs showed a flexion-type supracondylar fracture of the left distal humerus, with internal rotation of the distal fragment (Fig. 1).

The child was immediately taken to theatre for exploration of the elbow. It was first stabilised with overhead traction through a Kirschner wire inserted into the ulna, distal to the olecranon epiphysis. Under tourniquet control and with image intensification the joint was approached posteriorly, and a distally-based triceps flap was raised.

Exploration revealed a transverse supracondylar fracture of the flexion type with internal rotation of the distal fragment. The proximal fragment had lacerated the triceps muscle and a metaphyseal ridge which had button-holed through the triceps had completely divided the ulnar nerve. The ends of the nerve were cleanly sliced and lay buried in the triceps muscle (Fig. 2).

The ulnar nerve was transposed anteriorly. The fracture was reduced and stabilised with crossed Kirschner wires and a primary epineural repair of the ulnar nerve was performed with 8 O Prolene. The triceps flap was repaired and the wound was closed.

A padded backslab was applied, and changed for a dynamic splint on the third postoperative day. At two weeks...
an extension-blocking elbow splint was fitted.

During regular follow-up there was progressive neurological improvement. At her latest review, three years after the injury, she used the limb normally and admitted no disability despite loss of $20^\circ$ of extension. There was slight alteration in light touch sensation at the tips of the little and ring fingers. She had grade-$4+$ weakness of the intrinsic muscles innervated by the ulnar nerve, with minor clawing of the little finger.

**Discussion.** Isolated nerve injury is a rare but important complication of supracondylar fractures. Radial and median nerve injuries are more common in the more usual extension-type fractures, but damage to the ulnar nerve is more likely in flexion-type injuries. In 1938 Sorrel and Sorrel reported that 30% of flexion-type injuries are associated with ulnar neuropathy. All their cases had either neurapraxia or axonotmesis, but not neurotmesis.

When the distal fragment displaces anteriorly the ulnar nerve may be stretched or sharply angled over the fractured margin of the shaft. Injury is more likely if the distal fragment is displaced laterally because the ulnar nerve is pulled across the shaft. Nerves and vessels in front of the elbow are carried forwards and upwards away from the shaft and are therefore less vulnerable. In extension-type supracondylar fractures the ulnar nerve is carried away from the fracture edge (Hammond 1952; Lagrange and Rigault 1962).

Flexion-type fractures form between 1% and 10% of all supracondylar fractures. Fowles and Kassab (1974) reviewed 175 patients and found 17 flexion-type injuries, three of which had some deficit of the ulnar nerve. Two needed exploration of the ulnar nerve which showed that the nerve was sharply angulated over a jagged edge of bone as in our case.

McGraw et al (1986) found four ulnar-nerve injuries in 138 children with supracondylar fractures of the humerus; all improved without exploration. None of the fractures had anterior displacement of the distal fragment. Lechevallier and Lefort (1987) found 22 ulnar-nerve injuries in their series of 619 supracondylar fractures. Eight were completely paralysed but recovered. They only explored patients who had developed evidence of nerve injury after reduction of the fracture or had associated vascular injury. In none of the latter ten patients was the ulnar nerve found to be divided.

A conservative approach to nerve lesions is usually recommended since nerve damage requiring exploration is rare. Some advise exploration in the absence of recovery at 10 to 15 days (Sorrel and Sorrel 1938) but others are prepared to wait for six weeks (Seddon 1947). In our case early exploration was helpful, and may be considered when there is severe displacement of a flexion-type supracondylar fracture and obvious ulnar nerve injury.

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**REFERENCES**