IM Nails vs. Plate and Screws in Radial/Ulnar Fractures

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Introduction

Pediatric diaphyseal fractures of the radius/ulna are the third most common fractures in the pediatric population.[1-3] The goal of treatment for distal radius fractures is obtaining sufficient pain-free motion and allowing return to activities.[4] Here we provide a brief description of the evolution and use of intramedullary (IM) nails and plate fixation in these fractures.

Plate and screw fixation was first introduced by Carl Hansmann in 1886 and later evolved rapidly in the 20th century with the introduction of the x-ray and other surgical technique advancements[5]. Plate fixation by nature necessitates extensive surgical exposure, soft tissue stripping, and risk of hardware problems, which may require later removal of the implant.[6-8] IM nailing in the forearm was first reported in 1913. At that time, unacceptable non-union rates and a high degree of pronation/supination deficit at the proximal and distal radioulnar joints was noted.[9-11] The cause of this deficit was that restoration of proper rotational alignment, length, and anatomic bow of the radius are required for full pronosupination.[9]

Fracture fixation with flexible nails has gained popularity in recent years with proponents arguing that nailing results in decreased surgical dissection.[3,12,13] IM nail implementation for radial/ulnar fracture fixation should be considered over open fixation with plate and screws within the pediatric population for providing a less surgically invasive approach with outcomes that can be as safe and effective.

Case Description

A 13-year-old male athlete initially seen at an outside institution presented to our Emergency Department with x-rays that showed dorsally displaced radius and ulna fractures with a 3cm overriding fragment. They were taken to the OR for open reduction and intramedullary nailing of left radius and ulna fractures. After identifying the growth plate, a skin incision was made over the dorsum of the wrist and carried down to Lister's tubercle. An entry point was made dorsally in the distal radius, and a 2mm contoured titanium elastic nail was passed down the radius to the fracture site. Next, an incision was made over the distal ulna. After making an ulnar entry point, a second 2mm contoured nail was placed down the ulna to the fracture site. The fractures were reduced, and the nails were passed across the fracture sites proximally. Flouroscopy confirmed satisfactory position and anatomic alignment. The nails were retracted approximately 5mm for cutting, then advanced back with end caps on both. After capping, fluoroscopy was used to show normal pronation and supination as well as the interosseous space (Figure 1). At 6 weeks post nail fixation, they were transitioned to a volar splint and sling with continued activity restrictions and a plan for advanced range of motion (ROM) exercises (Figure 2). The patient returned at the 4-month post-op mark with full ROM and had both nails removed. The nails and end caps were localized with fluoroscopy and an incision was made over the end cap and dissection was carried down to the radial end cap. A second incision was made over the ulnar end cap. Both end caps and nails were removed without issue. By 6 weeks post-op the patient was cleared to return to all activities (Figure 3).

Discussion

Intramedullary nail fixation is best indicated for extra-articular distal radius fractures that are unstable and cannot be maintained with closed reduction. It provides a rigid construct and disperses loading forces through the distal radius via load-sharing as opposed to load-bearing.[14] Plate and screw constructs are subject to tremendous loads that can lead to implant failure and secondary displacement during the several months it can take for cortical defects of fractures to reintegrate.[15] In addition, IM nails require smaller incisions and avoid soft

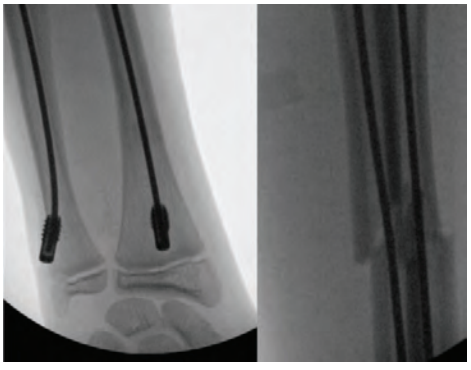

Figure 1. Intraoperative radiographs of radial and ulnar IM nails in appropriate placement across the fracture site (right) and with endcaps (left).

Figure 2. AP and Lateral radiographs 6 weeks s/p IM nail fixation of displaced radius and ulna fractures.

Figure 3. AP and Lateral radiographs 5 weeks s/p IM nail removal with appropriate radius and ulna alignment.

tissue injuries such as tendon irritation/rupture and carpal tunnel syndrome. Most complications of the ESIN technique are consequences of surgical unfamiliarity, therefore it is important to highlight proper technique. Penetration of the physis in pediatric patients should be avoided at all costs. Nail size is determined by measuring the canal diameter at the isthmus. Two nails of the same diameter will occupy 80% of the measured diameter. Radius nailing can be done in a retrograde approach to avoid the risk of damage to the deep branch of the radial nerve.[16] The ulna can be inserted with a retrograde approach or an anterograde approach depending on surgical preference. Contour of the nails should be done incrementally such that the ends occupy the metaphysis of the bone. Corkscrewing of nails can be avoided by rotating the tip in an arc of 180 degrees and opposite each other at the ends. TEN caps benefit by preventing soft tissue/tendon irritation, countering nail migration, and aiding in extraction of the nail. Protruding nail lengths should not exceed 5-7 mm, otherwise TEN caps will not adequately screw into the bone.

There is ongoing debate about plate removal vs. plate retention with at least one study finding that rates of complication in patients with retained plates were similar to those in patients who had their plates removed.[17] It's important to note that Peterson *et al.* advised plate removal in those involved in contact sports due to concern for refracture at the areas of stress generated by the retained plate, and that refracture rates in pediatric populations are influenced by plate characteristics, early removal, and lack of post-removal protection.[17, 18]

Conclusion

Internal fixation of radial/ulnar fractures with intramedullary nails in pediatric patients has advantages over ORIF with plate and screws. Surgical techniques involving IM nail placement are less invasive and require smaller incisions. In addition to more cosmetically appealing scars IM nails decrease risks of soft tissue/tendon irritation which, in the case of plate fixation, require an additional surgery for plate removal. Lastly many will argue that IM nails are less likely to be complicated by refracture than plate and screw fixation.

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