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Case Report

Takedown of Post-traumatic Radioulnar Synostosis with Distal Radius Osteotomy, Distal Ulna Reconstruction Using Fresh-Frozen Allograft, and Distal Radioulnar Joint Stabilization in an Adolescent: A Case Report

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Abstract

Post-traumatic distal radioulnar synostosis is a rare complication of forearm trauma that produces loss of pronation and supination and substantial functional impairment. It is uncommon in skeletally immature patients, in whom ongoing growth may compound deformity and bone loss. We report the case of a 13-year-old girl who presented with complete loss of left forearm rotation, chronic discomfort, and paresthesia ten years after a high-energy both-bone forearm fracture sustained at age three that had been treated with casting alone and without follow-up. Imaging demonstrated osseous fusion of the distal radius and ulna with marked radial articular malposition and lateral subluxation of the radiocarpal joint. She underwent a reconstruction comprising synostosis resection, a corrective osteotomy of the radius, distal ulnar reconstruction with a fresh-frozen allograft to restore length to a shortened, hypoplastic ulna, and distal radioulnar joint stabilization using a palmaris longus tendon graft. Intraoperative examination confirmed restoration of forearm rotation. At two-year follow-up, the patient had 50 degrees of adequate forearm rotation, no pain, no functional limitation, and no radiographic evidence of recurrent synostosis, and she had returned to school athletics. This case illustrates that, beyond simple bony-bridge excision, correction of the associated skeletal deformity and joint instability may be required to restore function in long-standing pediatric post-traumatic synostosis.

Keywords: *Radioulnar synostosis; Synostosis; Forearm Injuries; Bone Transplantation; Adolescent; Reconstructive Surgical Procedures*

1. Introduction

Distal radioulnar synostosis, whether congenital or acquired, is a rare but disabling condition that results in the loss of forearm rotation and significant functional impairment [1]. The congenital form typically presents in early childhood, whereas the acquired form often develops after trauma, infection, or surgery [2]. Post-traumatic radioulnar synostosis can occur anywhere along the forearm and has been reported in up to 9.4% of patients treated for forearm fractures with open reduction and internal fixation [2–4]. The incidence following nonsurgical management is not well documented.

The pathophysiology of post-traumatic synostosis involves abnormal bone healing between the radius and ulna, often influenced by factors such as soft-tissue trauma, comminuted fractures, Monteggia fractures, fractures of both bones at the same level, traumatic brain injury, delayed surgery, and prolonged immobilization [2,3,5]. Open fractures may also contribute, likely reflecting the severity of the associated soft-tissue injury [3]. Surgical factors—such as disruption of the interosseous membrane, improper placement of hardware or bone graft in the interosseous space, and soft-tissue trauma—may further increase the risk [5,6].

In skeletally immature patients, the acquired form is particularly problematic because of ongoing growth and the potential for worsening deformity over time. These patients often present with progressive loss of forearm rotation, deformity, and pain, all of which can significantly impair daily function [4]. Literature on post-traumatic distal radioulnar synostosis in skeletally immature patients remains limited.

Here, we report the case of a 13-year-old girl who developed post-traumatic distal radioulnar synostosis.

2. Case Presentation

A 13-year-old girl presented with absence of pronation and supination of her left forearm. She reported chronic discomfort, paresthesia, and difficulty with daily tasks, dressing and lifting objects. Her history revealed a high-energy forearm injury sustained at age three in a motor vehicle collision in Nigeria, with a subsequent both-bone forearm fracture. She was treated in a long-arm cast but received no follow-up after cast removal. On physical examination, the patient exhibited complete loss of forearm rotation and a pronounced deformity of the distal forearm. Distal neurologic and vascular assessments were normal. Radiographs revealed osseous fusion between the distal radius and ulna, accompanied by significant radial articular malposition. Computed tomography (CT) further demonstrated severe negative ulnar variance, chronic bony remodeling, and subluxation of the radiocarpal joint (Figure 1). Based on these findings, the patient and her guardian elected to pursue reconstructive surgery to restore forearm rotation and function.

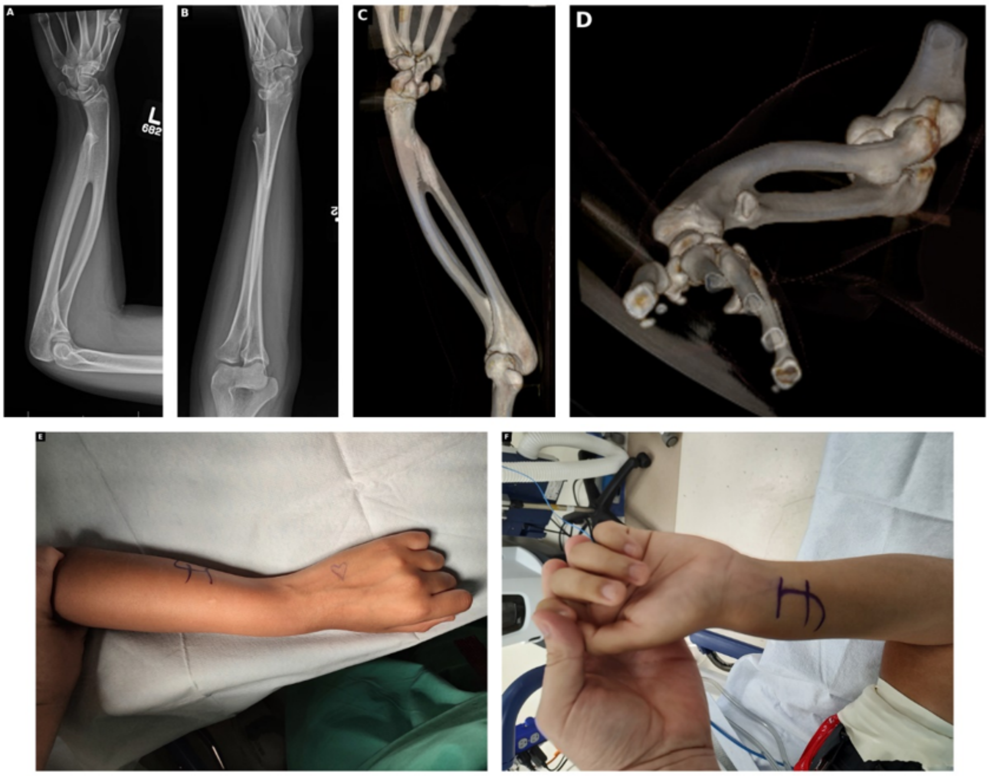

Figure 1. Preoperative imaging of the left forearm. (A, B) Anteroposterior and lateral radiographs showing osseous fusion of the distal radius and ulna with marked radial shaft bowing and negative ulnar variance. (C, D) Three-dimensional CT reconstructions of the synostosis and forearm deformity. (E, F) Clinical photographs demonstrating the deformity and fixed loss of rotation.

2.1 Surgical Technique

Under general anesthesia, a tourniquet was applied to the left upper extremity for hemostasis, with careful monitoring and periodic release. A volar incision over the flexor carpi radialis (FCR) was made, with dissection down to the synostotic bone bridging the distal radius and ulna. Using an oscillating saw, the bony bridge was resected until intraoperative fluoroscopy confirmed complete separation of the two bones (Figure 2a).

A TriMed volar locking plate was placed on the radius to guide a wedge osteotomy aimed at correcting the radial inclination. The excised cancellous bone from this osteotomy was morselized for use as autograft. The plate was then secured with appropriately sized screws, achieving stable realignment of the distal radius (Figure 2a-2b).

Next, through a dorsal wrist incision, the morselized bone graft from the radial osteotomy was used to fill the resultant gap, and the interosseous membrane was released to improve forearm motion. An ulna allograft (Musculoskeletal Transplant Foundation) was fashioned to restore length to the distal ulna, which had been significantly shortened and was markedly hypoplastic. The allograft was inset using a stair-step cut and secured with a Synthes plate and screws (Figure 3-4).

After releasing and reinflating the tourniquet, a palmaris longus tendon graft was harvested from the patient's forearm to reconstruct the distal radioulnar joint (DRUJ). Tunnels were drilled dorsal to volar in the ulnar corner of the distal radius and into the allograft ulna. The tendon was passed through these tunnels to reconstitute the dorsal and volar limbs of the triangular fibrocartilage complex (TFCC), and two tenodesis screws were used to secure the graft in the desired position (Figure 4). The excess tendon was used to recreate the flexor carpi ulnaris (FCU) tendon sheath, preventing subluxation. Both incisions were closed in layers, and a sugar-tong splint was applied. Intraoperative examination confirmed full supination and near-full pronation at completion of the procedure (Figure 5).

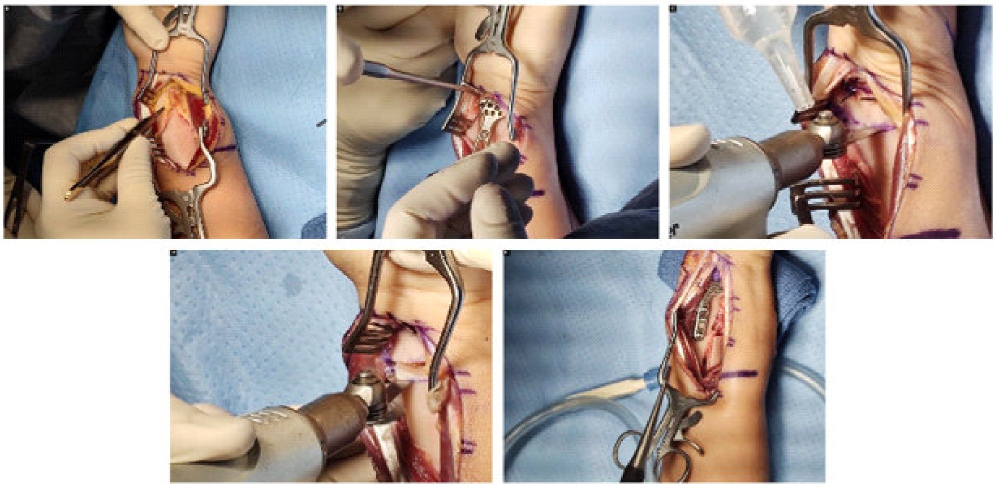

Figure 2a. Volar approach and takedown of the synostosis. (A, B) Volar exposure over the flexor carpi radialis. (C, D) creation of osteotomy. (E) distal radius plate fixation.

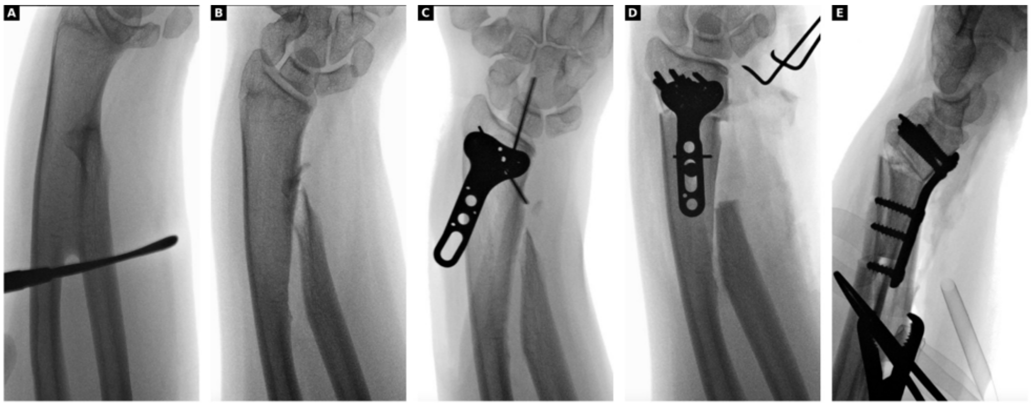

Figure 2b. Intraoperative fluoroscopy. (A) Radial deformity with guide wire. (B) Forearm after resection of the synostosis. (C) Radial osteotomy with provisional fixation. (D) Volar locking plate seated after the osteotomy. (E) Lateral view confirming alignment and hardware position.

Figure 3. Dorsal approach and ulnar allograft preparation. (A) Dorsal wrist incision. (B) Fresh-frozen ulnar allograft (Musculoskeletal Transplant Foundation) fashioned on the back table. (C) Stair-step inset of the allograft to restore distal ulnar length.

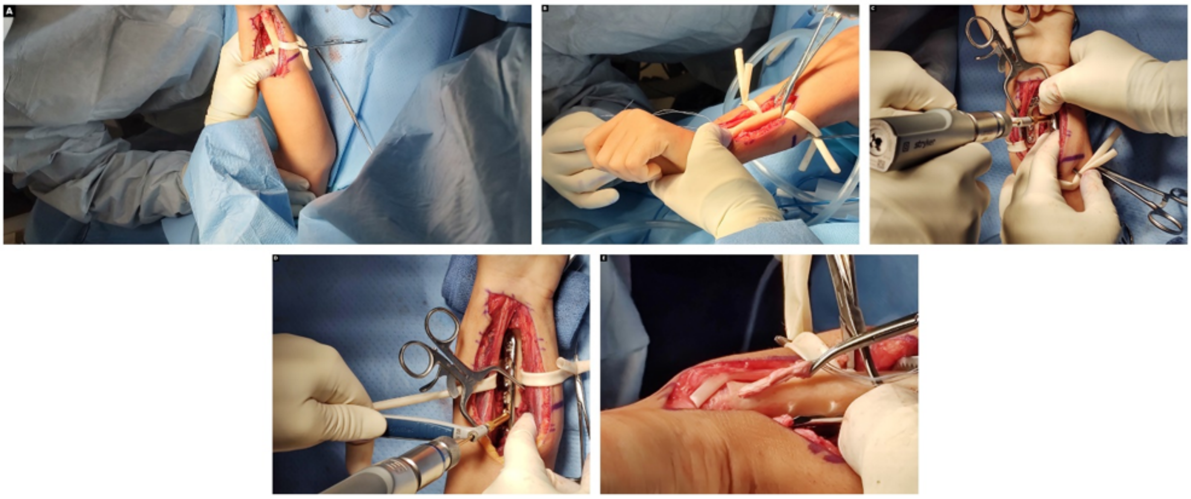

Figure 4. Distal ulnar reconstruction with fresh-frozen allograft and stabilization of the distal radioulnar joint. (A–D) Positioning and plate fixation of the ulnar allograft. (E) Creation of bone tunnels for the palmaris longus tendon graft used to reconstruct the distal radioulnar joint.

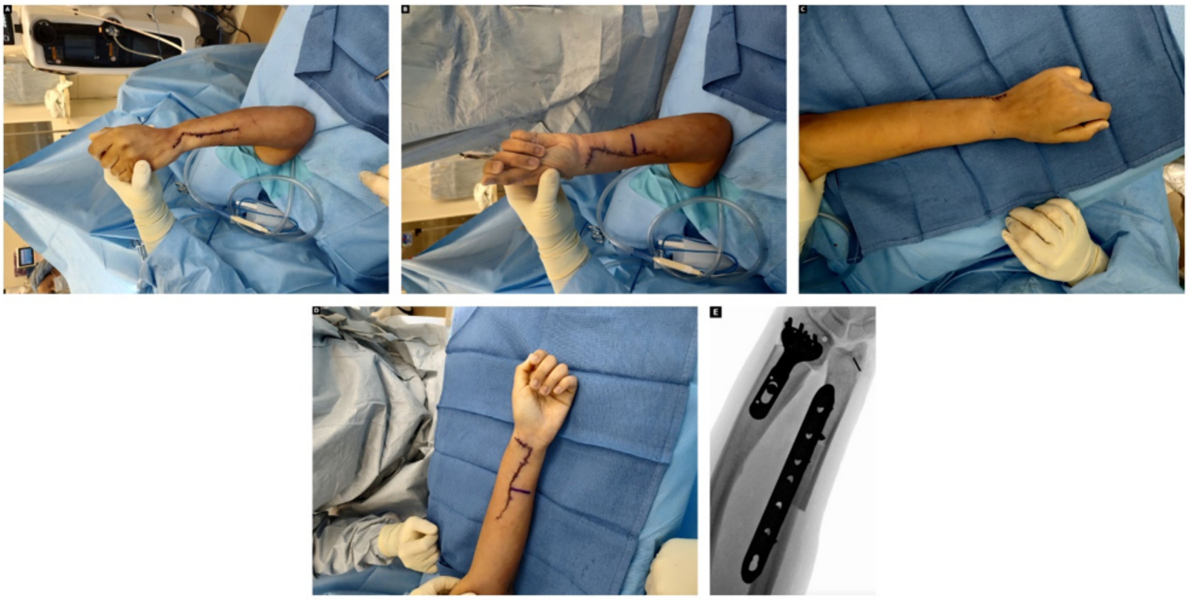

Figure 5. Postoperative appearance and correction of deformity. (A–D) Clinical photographs after closure demonstrating correction of the deformity and restored forearm rotation. (E) Intraoperative fluoroscopy showing anatomic alignment and fixation of the radial osteotomy and ulnar allograft.

2.2 Postoperative Course and Follow-up

Immediate postoperative radiographs showed appropriate alignment, securely placed hardware, and no residual bridging(Figure 5). Early in recovery, the patient progressed well, with improved forearm rotation and reduced pain. Follow-up radiographs confirmed healing at the radial osteotomy site, incorporation of the ulnar allograft, and intact hardware. The patient reported significantly improved cosmesis, functional improvement, and minimal pain during daily activities. At the two-year follow-up, she demonstrated pronation of 50 degrees and supination limited to 10 degrees. She reported no pain, no functional limitations in daily activities, and no paresthesia. She had resumed physical activity, actively participating in her school's athletics team. Radiographs confirmed stable hardware fixation, successful incorporation of the fresh-frozen allograft, and no signs of re-synostosis (Figure 6).

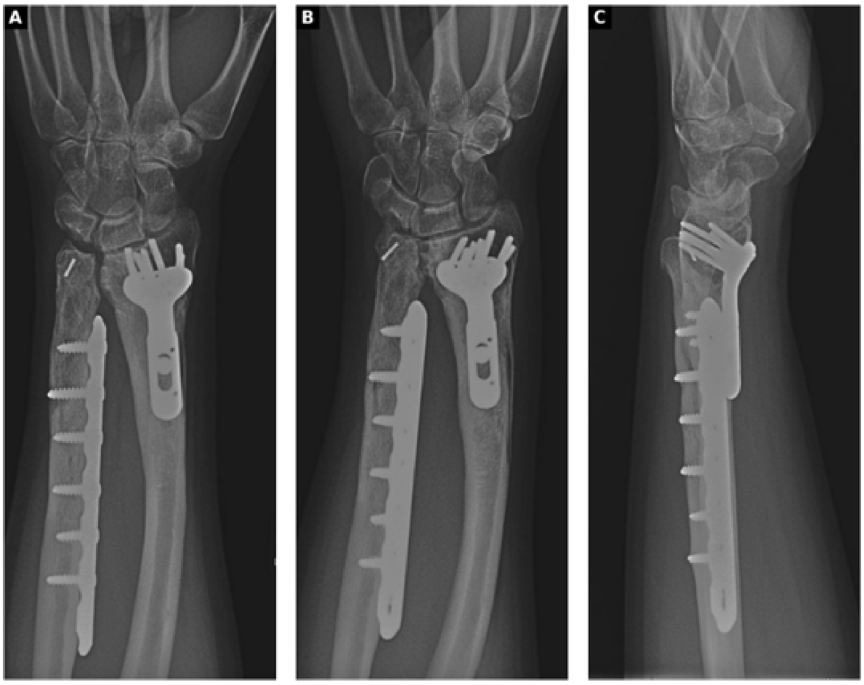

Figure 6. Two-year follow-up radiographs. (A–C) AP, oblique, and lateral views showing a healed radial osteotomy, incorporated ulnar allograft, maintained fixation, and no recurrence of synostosis.

3. Discussion

In this case, a multifaceted approach was essential. The osteotomy of the radius addressed the patient's pronounced radial bowing and inclination, while the ulnar allograft restored the length needed to realign forearm and wrist. The palmaris longus tendon graft served as a soft-tissue stabilizer allowing restoration of pronation and supination. This comprehensive plan resulted in substantially improved forearm function and cosmesis.

Post-traumatic radioulnar synostosis most often occurs proximally; the distal location seen here is comparatively rare [2,5]. Across reported cases, surgical resection of the bony bridge is the mainstay of treatment, but recurrence remains the principal complication, and many authors interpose biologic tissue (fat, fascia, or muscle) or rely on release of the interosseous membrane to reduce reformation [2,5,6]. In children, the optimal strategy is less well defined; Gounot et al. reported two pediatric distal cases treated successfully by resection alone, without interposition [4]. Our patient differed from most reports in that a long-standing, untreated injury from early childhood had produced not only a synostosis but also secondary radial bowing and a shortened, hypoplastic ulna, necessitating osteotomy and allograft reconstruction in addition to bridge excision and soft-tissue stabilization.

4. Conclusion

Radioulnar synostosis in the pediatric population is challenging to treat and may be accompanied by progressive deformity and bone loss, as in this case. With careful preoperative planning and an individualized reconstructive strategy that addresses the associated skeletal deformity and joint instability, the deformity can be corrected and forearm function restored.

Ethics Approval and Consent to Participate

Written informed consent for publication of this case and any accompanying images was obtained from the patient's legal guardian

Conflict of Interest

John J. Faillace reports a relationship with Tyber Medical LLC (Exalta) that includes: equity or stocks. John J. Faillace reports a relationship with BioPro. Miguel Jaramillo declares that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Author Contributions

MJ and JJF contributed to the conceptualization, analysis, investigation, methodology, writing, and review of the manuscript. JJF additionally provided project supervision.

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