Distal Radial Shaft Malunion and Distal Radioulnar Joint Instability 8 Years After Postoperative Plate Failure: A Case Report

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Acknowledgements We would like to acknowledge Kara Weber and Amber West for assisting with data collection.

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Funding The authors received no financial support for the research, authorship, and publication of this article.

Conflict of Interest The authors report no conflict of interest.

Informed Consent The patient was informed that the data concerning the case would be submitted for publication, and they provided verbal consent.

ABSTRACT

Radius shaft fractures often require operative treatment after skeletal maturity to restore functional range of motion. If the radial bow is not anatomically restored, pain and instability can occur from bony impingement and disruption of the distal radioulnar joint (DRUJ). We describe a 25-year-old woman with a radius shaft malunion and DRUJ instability. Eight years prior, at the age of 17, she underwent open reduction and internal fixation for a radial shaft fracture with subsequent reinjury at 10 weeks postoperatively. The reinjury was treated nonoperatively, and the patient went on to have painful range of motion and DRUJ instability. Radiographs at the time of presentation to our clinic revealed a bent compression plate. We performed surgical hardware removal, radial osteotomy with fixation, and DRUJ reduction. The patient healed and went on to have functional, painless range of motion with activities of daily living. While we do not have her prior records, we presume she re-fractured after her initial surgery, and the hardware subsequently failed. It is important to restore the normal radio-ulnar anatomic relationship in the forearm to give patients functional outcomes.

Keywords: Radius, Forearm, Osteotomy

INTRODUCTION

The radius and ulna are the most common fracture sites in patients younger than 20 years old.[1] Nonoperative treatment with closed reduction and casting is the gold standard when treating skeletally immature patients. However, some fractures require operative fixation, especially after skeletal maturity.[2]

The amount of acceptable angulation and deformity is based on the patient's skeletal maturity. For skeletally immature patients younger than 10 years old, surgeons should operatively treat radius fractures when there is greater than 20° of angulation in the distal shaft, 15° in the mid-shaft, and 10° in the proximal shaft.[2,3] In adolescents and adults, anatomically restoring the radial bow is the goal to preserve functional range of motion (ROM).[4,5] Adolescent patients over 10 years old have a higher risk of failing nonoperative treatment of forearm fractures than younger children, owing to decreased remodeling potential.[6]

Operative management is often required in the treatment of diaphyseal forearm fractures. During pronation and supination, the radius rotates around a stationary ulna with stability through the interosseous membrane.[5] Disruption of the normal radio-ulnar relationship is associated with distal radioulnar joint (DRUJ) instability.[7] If radial length and anatomic reduction are not achieved after reduction, patients can suffer from decreased and painful pronation and supination and DRUJ pathology.

Revision surgeries for failed implants are not benign, and the risk of complications is higher than for initial surgeries.[8,9] There is no clear standard regarding the treatment of failed hardware, and implant retention with loss of reduction can lead to malunion.

We describe a patient who presented with radial shaft malunion at the site of a bent compression plate placed 8 years earlier that was not removed after reinjury.

CASE REPORT

A 25-year-old, right-hand dominant woman presented to our clinic with right forearm and DRUJ pain with ROM. A review of her medical history revealed that she fractured her right distal radial shaft at age 17 from a fall while playing tennis. She was initially treated for this injury at an outside hospital with closed reduction and casting. After 8 weeks of casting, she underwent open reduction and internal fixation (ORIF) using a volar

Figure 1. *A) Anteroposterior and B) lateral radiographs of the right forearm at the time of preoperative clinic visit. C) Photograph of patient's forearms. D) Anteroposterior and E) lateral radiographs of the left forearm showing ulnar negative variance.*

locking compression plate, owing to malalignment. At 10 weeks postoperatively, her arm "buckled" when lowering herself into a pool, causing immediate and severe pain. Her surgeon at the time advised that no further treatment was warranted. We were unable to obtain any records from the time of her initial treatment. After initial treatment, she was unable to participate in sports because of pain and stiffness.

At 8 years after the initial injury at the age of 25, she experienced pain and decreased strength and was referred to our orthopaedic hand clinic for treatment options. On initial examination, it was observed that her right arm bowed dorsally. She had full, painful ROM in supination and pronation of her right arm, with a prominent distal ulna, mild (DRUJ) laxity, and palpable hardware. Passive pronation and supination resulted in a palpable, painful clicking over the dorsal protuberance. Radiographs of both forearms revealed that a diaphyseal distal third fracture of the radial shaft healed in varus malalignment, ulnar positive variance, with a bent six-hole plate at 27° of angulation and six screws (Figures 1A through C). Contralateral forearm films showed ulnar negative variance (Figures 1D and 1E). A small amount of lucency was noted along one of the distal screws with no other evidence of hardware loosening. Surgical treatment of the malunion and DRUJ instability were recommended.

In the operating room, a volar Henry approach to the forearm was used through the interval between the brachioradialis and flexor carpi radialis. Osteotomes were used to remove the initial hardware encased in bone and to create the osteotomy after closed DRUJ reduction under fluoroscopy. Fixation was achieved with a 3.5-mm low contact dynamic compression plate and screws (Figures 2A and 2B). After correcting her malunion and normal radial height, radiographs showed ulnar negative variance similar to her left wrist. She was discharged the same day in a splint.

Figure 2. *Immediate postoperative A) anteroposterior and B) lateral radiographs of the right wrist in a splint.*

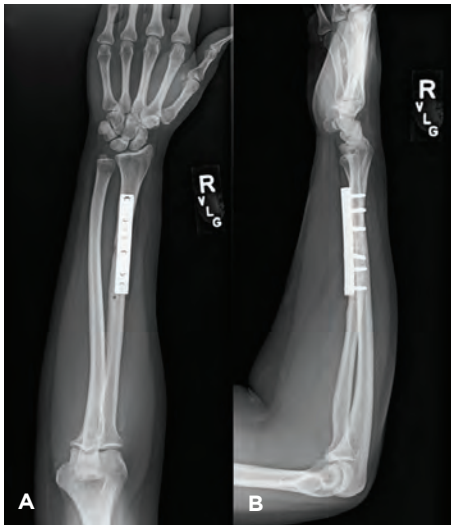

Figure 3. *A) Anteroposterior and B) lateral radiographs of the right forearm at 3 months postoperatively. Note the callus formation in the osteotomy site.*

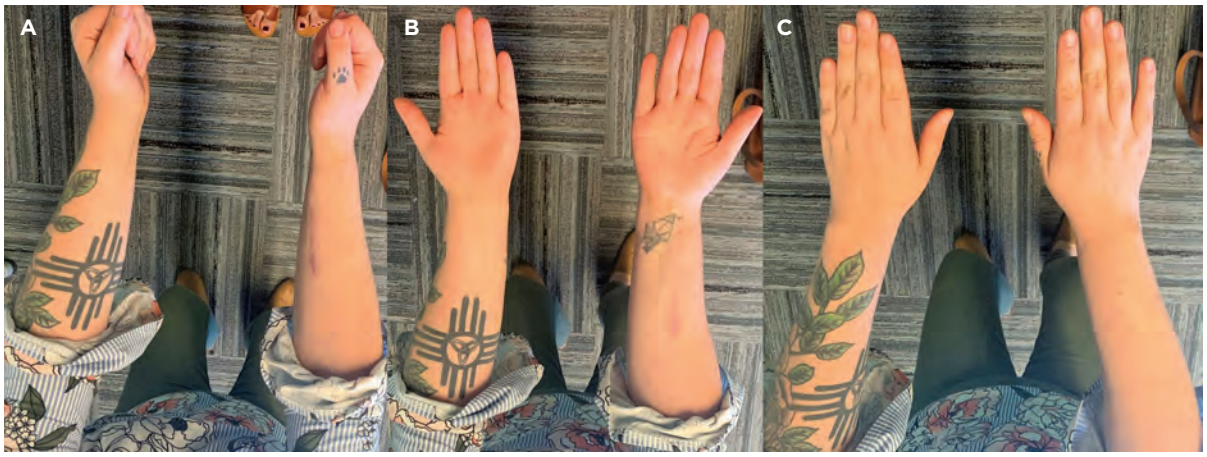

Figure 4. *Photograph showing patient's forearms in A) neutral, B) full supination, and C) full pronation at 15 months postoperatively.*

At her 2-week postoperative visit, she felt well and had returned to work. At 5 weeks postoperatively, she began pronation and supination with occupational therapy. At 7 weeks postoperatively, measurements revealed a ROM of 70° for wrist flexion, 65° for extension, 75° for pronation, and 65° for supination.

At the patient's 3-month postoperative visit, she was pleased with her decreased pain and rated it two out of ten. Radiographs showed evidence of bony healing of her osteotomy (Figures 3A and 3B). She had losses of 20° wrist extension and 30° wrist flexion, with a 20° decreased supination compared to her left side. She also noted some subjective decreased grip strength relative to her left arm that was improving. She was able to perform activities of daily living.

At 15 months postoperatively, the patient felt coming into the clinic for final evaluation was unnecessary as she was pleased with the surgery and could perform her activities without pain or difficulty. The patient shared images of her forearms during ROM. She had similar pronation and supination at extremes when compared side-to-side and symmetry when viewed from the radial side (Figures 4A through 4C).

DISCUSSION

Operative treatment of radius shaft fractures requires an anatomic restoration of the radial bow to restore pronation and supination and prevent DRUJ instability. Even when this goal is immediately achieved, the patient's follow-up should occur until radiographic healing. Postoperative events should be addressed appropriately. We report a case of hardware failure after repeat injury in a presumably skeletally mature patient, resulting in malunion with DRUJ instability and painful ROM. We do not have any records of the patient's initial injury. However, the patient presented with pain from activities of daily living and an obvious deformity with 27° of angulation that was unacceptable for her.

While the goal acutely is for anatomic reduction of the radius, sequelae of malunion can be challenging to treat. Acute reduction and fixation of these injuries, often with compression plating, is ideal for preventing soft-tissue contracture or injury of structures, such as the intraosseous membrane, DRUJ, and proximal radio-ulnar joint.[10] When malunions do occur, osteotomies have been described to correct these forearm deformities successfully.[7,11] One study showed better results when corrective osteotomy was performed within 1 year of injury.[12] While most forearm malunions occur after attempted nonoperative management, our patient's malunion presumably occurred after operative management and implant failure. She was treated successfully with an osteotomy.

Our patient did have DRUJ pain and instability with her malunion, which previous studies have described as radius diaphyseal malunion.[4,7] The radioulnar articulation is distally stabilized by the triangular fibrocartilage complex.[5] This can be disrupted when the normal anatomic relationship between the radius and ulna no longer exists, such as diaphyseal radius shaft fracture and malunion, which causes pain and instability. DRUJ instability after radius shaft malunion has been successfully treated with corrective osteotomy.[12] Our patient's ulnar positive malunion was restored to ulnar negative variance similar to her left wrist after osteotomy.

Currently, minimal data support retained implants in patients after hardware failure.[13] Known complications of revision surgery exist, such as neurovascular injury, radio-ulnar synostosis, infection, and compartment syndrome. However, our patient was dissatisfied with the nonoperative treatment of her malunion.[14] Patients should be educated about these risks and known risks of diaphyseal forearm malunion.

Although nonoperative management of radius shaft fractures is possible in skeletally immature patients, especially in patients under 10 years of age, adolescents and adults often require ORIF with compression plating to anatomically restore the radial bow. Our patient had underdone ORIF for an injury 8 years before

presentation at our clinic. She was treated successfully with corrective osteotomy after malunion of her radius shaft fracture.

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