Carpal Tunnel Syndrome Following Corrective Osteotomy for Distal Radius Malunion: A Rare Case Report and Review of the Literature

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Abstract

Background: Although median nerve neuropathy and carpal tunnel syndrome (CTS) are known complications of both untreated and acutely treated distal radius fracture, median neuropathy after correction of distal radius malunion is not commonly reported in hand surgery literature. We describe a patient with severe CTS after corrective osteotomy, open reduction internal fixation (ORIF) with a volar locking plate (VLP), and bone grafting for distal radius malunion. **Methods:** We report a case of severe acute CTS as a complication of corrective osteotomy with bone grafting for distal radius malunion. **Results:** The patient was treated with surgical exploration of the median nerve and carpal tunnel release. **Conclusion:** The authors report a case of acute CTS after ORIF with VLP for a distal radius malunion warranting surgical exploration and carpal tunnel release. Treatment teams must be aware of this potential complication so that the threshold for reoperation is low and irreversible damage to the median nerve is prevented.

Keywords: distal radius, malunion, corrective osteotomy, carpal tunnel syndrome, median nerve

Introduction

Distal radius fractures are common traumatic injuries, and malunion is not an infrequent complication.¹⁶ Patients with symptomatic malunions, such as pain or diminished range of motion at the wrist, or those with potential for altered biomechanics, are recommended to undergo corrective osteotomy; there are numerous surgical approaches and repair methods described.¹¹ Although median nerve neuropathy and carpal tunnel syndrome (CTS) are known complications of both untreated and acutely treated distal radius fractures, median neuropathy after correction of distal radius malunion is not commonly reported in hand surgery literature. We describe a patient with severe CTS after corrective osteotomy, open reduction internal fixation (ORIF) with a volar locking plate (VLP), and bone grafting for distal radius malunion. The patient was successfully treated with surgical exploration and release of the carpal tunnel, which improved her clinical symptoms. We further present a review of the literature as it pertains to correction of distal radius malunion and acute CTS.

Case Report

A 33-year-old right-hand-dominant female with history of left distal radius fracture treated with closed reduction

and percutaneous pinning at an outside hospital was referred to a tertiary medical center for further follow-up. Upon presentation, she was found to have malunion of her distal radius with loss of radial height, loss of radial inclination, and volar subluxation of the carpus (Figure 1). She had no significant medical history and was a nonsmoker.

On physical examination, she presented with flexion limited to 30° and extension limited to 35°. Pronation and supination were significantly limited, with inability to supinate past 25°. Preoperative neurosensory examination was normal.

Computed tomography (CT) scan demonstrated a volar Barton's fracture and ORIF was planned (Figure 2 and 3). However, discovery of pregnancy prevented immediate intervention and delayed treatment for 2 months until she was cleared by obstetrics and gynecology.

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Figure 1. Preoperative posteroanterior radiograph demonstrating loss of radial height, loss of radial inclination, ulnar positive variance, and distal radius malunion.

Figure 2. Preoperative lateral radiograph demonstrating volar subluxation of the carpus with loss of volar tilt and abnormal tear drop angle.

Four months after her original procedure, the patient underwent volar osteotomy and open reduction and internal fixation of the malunited left distal radius fracture via an extended flexor carpi radialis approach. The median nerve was protected

Figure 3. Preoperative computed tomography scan demonstrating the volar Barton's fracture with delineation of the volar shear fragment.

Figure 4. Intraoperative fluoroscopic image demonstrating the use of laminar spreader to distract the distal fragment and restore the height of the radius.

at all times. The radial septum was released, including a step-cut tenotomy of the brachioradialis. Osteotomy was performed through the old fracture line using sharp osteotomes. A laminar spreader was used to distract the radius (Figure 4). The proximal segment was pronated, and the contracted dorsal periosteum was released sharply under direct vision. Reduction maneuvers were applied, and fixation was performed using the

Figure 5. Intraoperative view demonstrating the course of the median nerve after full carpal tunnel release. It was found to be intact throughout its course but acutely compressed within the carpal tunnel.

Figure 7. Two-month postoperative lateral image demonstrates restoration of normal positioning of carpus as it relates to the volar cortex of the radius. Radiographs demonstrate ongoing healing of bone graft with appropriate placement of hardware.

Figure 6. Two-month posteroanterior postoperative radiograph demonstrating restoration of radial height, radial inclination, and absence of ulnar positive variance. Radiograph demonstrate ongoing healing of bone graft with appropriate placement of hardware.

Skeletal Dynamics (Miami, FL) Geminus distal radius VLP. A significant volar and radial bone gap was present, and a combination of cancellous allograft, calcium phosphate, and bioactive glass was packed in to the defect. Final fluoroscopic images demonstrated improvements in all radiographic parameters: Preoperatively, the patient was 4 mm ulnar positive and had radial inclination of only 2°, whereas postoperatively, she improved to 0.5 mm ulnar negative with radial inclination of 15°. Furthermore, her carpus was no longer volarly subluxed. The patient was placed in a sugar-tong splint and discharged on the same day.

On postoperative day (POD) 5, the patient complained of numbness in the median nerve distribution. On exam, 2-point discrimination was normal up to the level of interphalangeal joint of the thumb and proximal interphalangeal joints of the index, middle, and ring fingers. Sensation to pinprick and light touch was diminished distally. The radiograph confirmed improved fracture reduction with appropriate placement of hardware. The patient was believed to have neuropathic pain from intraoperative stretch on the median nerve, and was discharged with appropriate recommendations to call if symptoms worsened.

On POD 9, the patient contacted the provider and described worsened paresthesias, which were now severe enough to wake her from sleep. Examination demonstrated absent 2-point discrimination in the median nerve distribution. The patient was admitted for emergent median nerve

exploration and decompression. Intraoperatively, the median nerve segment within the carpal tunnel was flattened and edematous, suggesting compression, while the segment proximal to the carpal tunnel was unremarkable. The transverse carpal ligament was released under direct visualization (Figure 5). By POD 10/1, her painful paresthesias had resolved and she was discharged home. At her next 2 postoperative visits, she was found to have improving sensibility in the median nerve distribution. CT scan and radiographs obtained at 2 months demonstrated ongoing fracture healing and appropriate placement of hardware (Figure 6 and 7).

Discussion

Distal radius fractures are common injuries, estimated to comprise approximately 10% of all fractures.¹⁶ The incidence of acute CTS after distal radius fracture is estimated to range from 5.4% to 8.6%, whereas the incidence of delayed or late CTS is estimated to be between 0.5% and 22%.¹² Malunion and posttraumatic arthritis are potential complications due to inadequate reduction, with malunion reported at significantly higher rates after conservative rather than operative management.¹⁶ Although some patients with malunion are symptom free, others may complain of pain, limited range of motion, and cosmetic deformity. Patients may also present with concerning radiographic parameters such as loss of radial height, tilt, and/or inclination; numerous articles have correlated the disturbance of these normal values to the alteration in wrist kinematics and abnormal redistribution of loads borne by the wrist.¹³ The goals of treatment of both extra-articular and intra-articular malunions are to alleviate the aforementioned symptoms; restore normal function at the radiocarpal, midcarpal, and/or the distal radioulnar joints (DRUJ), and to correct potential biomechanical disturbances predicted by radiographic abnormalities.

We performed a computerized literature search on 6 medical databases from inception until November 2016, including PubMed, Web of Science, Ovid MEDLINE, Ovid EMBASE, SCOPUS, and Cochrane Library, using the keywords: “distal radius,” “malunion,” “osteotomy,” “carpal,” and “median,” to investigate previous reports of CTS after corrective osteotomy for distal radius malunion, and were surprised to find a paucity of cases. Several articles have reported CTS to be a *potential* complication of corrective osteotomy for distal radius malunion but do not mention specific cases.^{3,5,10,15} Indeed, reports of CTS following corrective osteotomy for distal radius malunion in the literature are elusive and frequently lacking in patient detail.^{1,2,8,9} Abramo et al report one postoperative CTS necessitating carpal tunnel release in a patient treated with osteotomy and bone grafting for distal radius malunion, but do not indicate the timing of the complication and report only meta-data for the entire patient cohort.¹ Mahmoud et al report one “transient median neuritis” after corrective osteotomy in the “early-post period” that resolved within 3 months without

intervention.⁹ Two additional articles describe late-onset CTS requiring carpal tunnel release after corrective osteotomy, one patient requiring release 6 months after corrective osteotomy and another 4 years after osteotomy.^{2,8} Given the significant passage of time between corrective osteotomy and CTS in both of these cases, it unclear whether the osteotomy was indeed causative for CTS. Thus, though published reports acknowledge the potential for median nerve compression or injury caused by corrective osteotomy, ours is one of the few to report acute CTS whose symptoms were severe enough to warrant surgical exploration and carpal tunnel release in the immediate postoperative period.

The mechanism of CTS in our patient is likely multifactorial. Median nerve neuropathy has been reported in patients with symptomatic malunion of distal radius fractures, suggesting that the malunion itself, through mass effect, posttraumatic alterations to the carpal tunnel anatomy, or another mechanism, may cause median nerve compression and subsequent symptoms.^{11,12,17} A recent study evaluated the prevalence of CTS in 30 patients with symptomatic distal radius malunion. They report that while only 7 patients had overt symptoms of CTS, 15 had evidence of CTS via nerve conduction studies. This suggests that many patients with symptomatic distal radius malunions may have “subclinical” CTS (ie, nerve conduction abnormalities with no clinical symptoms) that may predispose to the development of overt CTS.¹¹ Thus, it is likely that our patient was suffering from subclinical median nerve compression that was exacerbated by the amount of distraction performed during corrective osteotomy, leading to acute CTS postoperatively. It is also possible that the VLP used for fixation contributed to the development of acute CTS, as CTS is a known complication of unstable distal radius fractures repaired with VLPs as compared with other methods of repair.^{4,6,18}

The potential for irreversible damage necessitates a discussion on the utility of prophylactic carpal tunnel release. Some authors perform a carpal tunnel release in patients treated with corrective osteotomy for distal radius malunion,^{7,14} though the decision remains in the hands of the treatment teams with no agreed-upon standards of care. Although prophylactic carpal tunnel release is not indicated in patients with asymptomatic distal radius fractures, the threshold for release in patients with distal radius malunions may be lower, given the high incidence of subclinical CTS in patients with malunions.^{11,12} It thus stands to reason that prophylactic carpal tunnel release may be warranted for such patients even in the absence of overt clinical symptoms of CTS, especially in those patients treated through a volar approach with volar fixation.

Conclusion

In summary, the authors report a case of acute CTS after ORIF with VLP for a distal radius malunion warranting

surgical exploration and carpal tunnel release. Treatment teams must be aware of this potential complication so that the threshold for reoperation is low and irreversible damage to the median nerve is prevented.

Authors' Note

All work was performed at the Yale School of Medicine and the NYU School of Medicine.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

All study procedures were followed in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008.

Statement of Informed Consent

Informed consent was obtained from the patient discussed in the case report.

Declaration of Conflicting Interests

The author(s) declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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