Check for updates

Surgery Article

HAND
2022, Vol. 17(5) 952–956
© The Author(s) 2020
Article reuse guidelines:
sagepub.com/journals-permissions
DOI: 10.1177/1558944720964965
journals.sagepub.com/home/HAN

Outcomes of Type I Open Distal Radius Fractures: A Comparison of Delayed and Urgent Open Reduction Internal Fixation

Tyler W. Henry[1], Jonas L. Matzon[2], Richard M. McEntee[2], and Kevin F. Lutsky[2]

Abstract

Background: Type I open distal radius fractures treated with open reduction internal fixation (ORIF) have demonstrated minimal risk of infection. For this reason, they may not require urgent surgical treatment. The purpose of this study was to evaluate the outcomes of patients with type I open distal radius fractures treated with delayed ORIF compared with urgent ORIF. **Methods:** We identified all Gustilo-Anderson type I open distal radius fractures that had undergone ORIF using volar plating over a 5-year period. Patients were stratified into those treated urgently within 24 hours and those scheduled for delayed surgery. Outcomes including functional scores, complications, reoperations, and radiographic measures were compared. **Results:** Twenty-four patients (17 treated urgently and 7 treated delayed) had open type I distal radius fractures. All patients were started on empiric antibiotics at initial presentation—patients in the delayed treatment group were prescribed oral antibiotics, whereas those admitted for urgent treatment received intravenous antibiotics. There were no infections in either group and a single reoperation in each group. The mean postoperative Quick Disabilities of the Arm, Shoulder, and Hand score was 29 (range = 0-77) and did not differ significantly between delayed (mean = 19) and urgent (mean = 38) treatment. Rate of complications and radiographic measures did not differ significantly between the groups. **Conclusions:** Type I open distal radius fractures appear amenable to delayed outpatient ORIF provided that the wound is clean at the time of initial presentation and that antibiotics are initiated appropriately. Further prospective studies comparing delayed and urgent treatment strategies are warranted.

Keywords: distal radius, fracture/dislocation, diagnosis, open fractures, trauma, wrist, treatment, research and health outcomes, outcomes

Introduction

Open distal radius fractures are uncommon injuries that are traditionally treated urgently.[1,2] Acceptable outcomes have been reported in the literature using early surgical intervention in combination with antibiotic therapy.[3] Surgery typically involves irrigation and debridement (I&D) with fracture stabilization. While high-energy fractures with contaminated wounds may require staged or definitive management with external fixation and serial I&Ds, open reduction internal fixation (ORIF) at the time of debridement has demonstrated safety and efficacy for less severe injuries.[4,5] Although concern remains for a higher risk of postoperative infection in open compared with closed fractures,[6,7] Gustilo-Anderson type I open fractures[8] appear to behave similarly to closed injuries.[6,9] In fact, type I open distal radius fractures treated with ORIF have demonstrated minimal risk of infection and have functional outcomes comparable to closed fractures.[3,4]

Given the limited data available, the necessity of urgent surgery for type I open distal radius fractures is unclear. The purpose of this study was to compare the outcomes of patients with type I open distal radius fractures treated with delayed ORIF with those treated with urgent ORIF. We hypothesized that the overall outcomes, including functional scores and reoperation/complication rates, would not differ significantly between urgent and delayed treatment.

[1]Thomas Jefferson University, Philadelphia, PA, USA
[2]Rothman Orthopaedic Institute, Philadelphia, PA, USA

Corresponding Author:
Kevin F. Lutsky, Rothman Orthopaedic Institute, 925 Chestnut Street, 5th Floor, Philadelphia, PA 19107, USA.
Email: lutskyk1@gmail.com

Materials and Methods

Institutional review board approval was obtained with a waiver of informed consent per institutional protocol. The surgical billing database of a single, large orthopedic group was searched to identify all patients who underwent simultaneous I&D and ORIF for an open distal radius fracture (billed Current Procedural Terminology codes of [11010, 11011, or 11012] and [25607, 25608, or 25609[) between 2014 and 2019. This produced a cohort of 115 patients. These charts were then reviewed to identify those with a documented type I open fracture who were treated urgently at the time of presentation to the emergency department (ED), or delayed as an outpatient, using ORIF with volar plating. The urgent treatment group was considered to be those patients who presented to the ED, were admitted for treatment, and underwent surgery within 24 hours of presentation. The delayed treatment group was considered to be those patients who were discharged from the ED, were seen in the outpatient office, and underwent semi-elective, outpatient surgery. Patients in this group were excluded if they had undergone a formal I&D (without fixation) in the operating room at the time of presentation to the ED. Other exclusion criteria included fractures treated with fixation other than a volar plate (ie, pins, dorsal plate, spanning plate, external fixator), fractures in skeletally immature patients, fractures in polytrauma patients, or fractures with insufficient follow-up or documentation.

A total of 24 patients met inclusion criteria. Twenty of these patients (13 urgent, 7 delayed) were treated by 1 of the 9 fellowship-trained, orthopedic hand surgeons. The remaining 4 patients were treated urgently by on-call orthopedic surgeons, who were not fellowship-trained in hand surgery. Electronic medical records and postoperative radiographs were reviewed to collect demographic and outcome variables that included Gustilo-Anderson fracture classification,[8] AO fracture type, treatment course, postoperative complications, reoperations, and functional outcome scores (Quick Disabilities of the Arm, Shoulder, and Hand [QuickDASH]) at final follow-up. In addition, radiographic measurements were obtained at final follow-up. All patients were followed until radiographic healing.

Descriptive statistics were collected and reported. Reoperation and complication rates were compared between urgent and delayed treatment using the χ^2 test. Numerical outcome measures were assessed for normality using the Shapiro-Wilk test, and their mean values were subsequently compared using the Mann-Whitney *U* or independent samples *t* test. Statistical significance was established at $P < .05$. A post hoc power analysis identified a power of 0.40 in the testing of mean differences.

Results

Twenty-four patients with type I open distal radius fractures were treated with ORIF using volar plating. There were 6 men and 18 women in the study cohort with a mean age of 63 years (range = 20-89 years). All wounds were less than 1 cm in diameter or length and without gross contamination. Seven patients were treated with delayed ORIF at a mean time from injury to surgery of 7 days (range = 2-15 days) and a mean time from initial office visit to surgery of 5 days (range = 1-8 days). Seventeen patients were treated with urgent ORIF within 24 hours of presentation. Demographic characteristics did not differ significantly between the 2 treatment groups (Table 1). The mean time to final clinical follow-up was 58 weeks (range = 11-276 weeks).

Preoperatively, all patients were treated with empiric antibiotics. In the delayed treatment group, all 7 patients were started on a course of oral antibiotics at the time of presentation that was continued through the time of surgery (5 cephalexin, 1 amoxicillin/clavulanic acid, 1 clindamycin). In the urgent treatment group, all 17 patients received empiric intravenous antibiotics, and 9 of those patients (53%) were continued on intravenous antibiotics for a full 48 hours. Following surgery, 8 patients treated urgently were prescribed a course of oral antibiotics (6 cephalexin, 2 clindamycin). Two patients received both 48 hours of intravenous antibiotics and a course of oral antibiotics.

Postoperatively, there were no infections within the cohort. The complication rates did not differ significantly between the 2 treatment groups (Table 2). There was a single reoperation in each treatment group (Table 2). One patient treated with urgent ORIF required removal of a symptomatic ulnar pin, and 1 patient treated with delayed ORIF underwent removal of ulnar hardware with distal ulna resection after hardware failure. The mean radiographic measures are presented in Table 3. The mean postoperative QuickDASH score was 29 (median = 30, range: 0-77) and did not differ significantly between delayed (mean = 19, median = 20) and urgent (mean = 38, median = 35) treatment (Mann-Whitney *U* testing of means: $P = .310$) groups.

Discussion

Although open distal radius fractures are traditionally treated emergently, some evidence suggests that type I open fractures may be treated in a delayed fashion.[1] In this series of patients treated with volar plating, outcomes were similar regardless of the time to treatment, and there were no postoperative infections. The complication and reoperation rates were also similar after urgent and delayed surgery, and the complication profile of patients treated nonemergently was similar to closed fracture fixation.[10,11]

Table 1. Demographic Characteristics of the Study Cohort, Stratified by Treatment Group.

Variable	Study population (N = 24)	Range	Delayed treatment (n = 7)	Range	Urgent treatment (n = 17)	Range	*P* value
Mean age, y	63	20-89	63	47-73	63	20-89	.973
Dominant-sided Injuries	8	—	1	—	7	—	.174
AO fracture classification							.635
Type A	7	—	1	—	5	—	
Type B	2	—	1	—	1	—	
Type C	17	—	5	—	11	—	
Mean BMI	28	17-43	30	21-40	27	17-43	.360
Patients with hypertension	8	—	2	—	6	—	1.00
Patients with diabetes	0	—	0	—	0	—	—
Current tobacco users	2	—	0	—	2	—	.577
Mean time to follow-up, wk	58	11-276	32	11-123	70	11-276	.318

Note. BMI = body mass index.

Table 2. Reoperation and Complication Occurrences Within the Study Population, Stratified by Treatment Group.

Variable	Study population (N = 24)	Delayed treatment (n = 7)	Urgent treatment (n = 17)	*P* value
Total reoperations	2	1	1	.507
Total complications	7	4	3	.134
Hardware failure	1	1[a]	0	
DRUJ arthritis	2	1	1	
Flexor tendon adhesions	1	1	0	
Radioulnar synostosis	1	1	0	
CRPS	1	0	1	
Symptomatic hardware	1	0	1[a]	

Note. CRPS =complex regional pain syndrome; DRUJ = distal radioulnar joint.
[a]Required reoperation.

Table 3. Mean Values of Radiographic Measurements at Final Follow-up, Stratified by Treatment Group.

Radiographic measure	Study population (N = 24)	Delayed treatment (n = 7)	Urgent treatment (n = 17)	*P* value
Volar tilt, deg	9	10	8	.610
Radial tilt, deg	22	23	22	.781
Radial height, mm	12	13	11	.222
Ulnar variance, mm	0.7	1	0.6	.676

Prior studies have demonstrated similar outcomes between type I open and closed fractures. Kim and Park compared 20 patients with Gustilo-Anderson type I and II open fractures treated with volar plating with a matched cohort of similarly treated patients with closed fractures and found no significant differences in wrist range of motion (ROM), radiographic measures, grip strength, DASH scores, or complications between the 2 groups at 1 year postoperatively. There were 2 superficial infections in the open fracture group and 1 superficial infection in the closed fracture group. All patients with open fractures underwent surgery within 48 hours of presentation.[12] In a similarly designed study, MacKay et al compared 18 open distal radius fractures (17 of 18 were Gustilo-Anderson type I or II) with matched controls. The open fracture cohort underwent external fixation or ORIF within 24 hours of presentation, whereas the closed fracture group treatment included ORIF, external fixation, and closed-reduction percutaneous pinning. They reported no significant differences in ROM, grip strength, radiographic measures, DASH scores, or complications between the closed and open fracture groups. Each group had a single pin tract infection.[3]

Although these studies demonstrated similar outcomes between open and closed fractures, patients with open fractures were treated urgently. It is impossible to extrapolate whether these results would have been the same had surgery been delayed in the open group. Kurylo et al[4] assessed the effects of delayed debridement of open distal radius fractures and found no increased risk of infection. In their study, they defined delayed treatment as greater than 6 hours from initial presentation, but the average time to surgery within this group was 20 hours, and all of their patients were treated upon admission to the ED. In contrast, the patients in our delayed ORIF group were treated on an outpatient fashion at an average of 7 days following the injury.

The benefit of emergent surgery for Gustilo-Anderson type I open fractures has been questioned previously. In a study of 91 type I open fractures (13 of which involved the

wrist), Yang and Eisler reported zero infections despite the fact that only 1 patient underwent operative debridement within 12 hours of presentation. In their cohort, the average time to surgery was 5 days.[9] However, unlike the patients in our delayed ORIF group, all patients in that study were admitted to the hospital and treated with at least 48 hours of intravenous antibiotics.[9] In addition, based on a review of 42 open fractures treated emergently, Glueck et al suggested that wound contamination, more so than Gustilo-Anderson type, predicts postoperative infection risk. However, none of the infections within their cohort occurred in Gustilo-Anderson type I fractures.[13]

In our study, we found that patients with type I open distal radius fractures, who are discharged from the ED with outpatient follow-up and then scheduled in semi-elective fashion for ORIF, can expect outcomes similar to open fractures treated urgently. These findings align with prior studies suggesting that low-grade open fractures behave more similarly to closed injuries. It may be that the level of wound contamination or severity of the open wound, rather than simply the presence of an open wound, better predicts infection risk. Based on our data, radiographic and clinical outcomes do not deteriorate with delayed treatment.

There are limitations to our study. First, open distal radius fractures are relatively uncommon, and therefore, the subset of patients treated in delayed fashion was small. It is possible that there were fractures treated in a delayed fashion in which the operating surgeon did not bill for an open fracture I&D despite a small, type I open wound. These fractures would not have been captured in our database search and could have contributed to the small study population. However, to the extent that this occurred, it suggests that the operating surgeon viewed them more as closed fractures, with the small open wound not warranting discrete intervention. Second, the specific nature and duration of antibiotic therapy were not standardized and was left to the discretion of surgeon and/or ED. There may be an optimal antibiotic regimen for treating patients in delayed fashion that we are not able to identify. Third, our findings may not be applicable to patients treated with alternative methods (ie, pins, dorsal plate, spanning plate, or external fixation). We chose to include only patients who were treated with volar plating to eliminate the potential variability with other fixation methods. Although we did not detect a difference in DASH scores between groups, this may have been due to the study being underpowered to find a difference. Finally, due to the nature of our study, it is possible that the fractures in the 2 groups were not equivalent. We attempted to minimize this retrospective limitation by only evaluating type I open injuries.

In conclusion, type I open distal radius fractures appear amenable to delayed, outpatient ORIF provided that the wound is not grossly contaminated at the time of injury. In our practice, for patients who present with type I open fractures, we recommend that the wound be cleaned at the time of initial presentation and that empiric antibiotics be started. Patients can then be scheduled for semi-elective surgery on an outpatient basis.

Ethical Approval

This study was approved by our institutional review board.

Statement of Human and Animal Rights

This article does not contain any interventions with human or animal subjects.

Statement of Informed Consent

Institutional review board approval was obtained for this study, with a waiver of informed consent per institutional protocol.

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.

Funding

The author(s) received no financial support for the research, authorship, and/or publication of this article.

ORCID iDs

Tyler W. Henry https://orcid.org/0000-0001-9638-5424
Richard M. McEntee https://orcid.org/0000-0002-4098-0125
Kevin F. Lutsky https://orcid.org/0000-0003-1393-2264

References

1. Iorio ML, Harper CM, Rozental TD. Open distal radius fractures: timing and strategies for surgical management. *Hand Clin*. 2018;34(1):33-40. doi:10.1016/j.hcl.2017.09.004.
2. Jawa A. Open fractures of the distal radius. *J Hand Surg Am*. 2010;35(8):1348-1350. doi:10.1016/j.jhsa.2010.06.008.
3. MacKay BJ, Montero N, Paksima N, et al. Outcomes following operative treatment of open fractures of the distal radius: a case control study. *Iowa Orthop J*. 2013;33:12-18.
4. Kurylo JC, Axelrad TW, Tornetta P 3rd, et al. Open fractures of the distal radius: the effects of delayed debridement and immediate internal fixation on infection rates and the need for secondary procedures. *J Hand Surg Am*. 2011;36(7):1131-1134. doi:10.1016/j.jhsa.2011.04.014.
5. Harper CM, Dowlatshahi AS, Rozental TD. Evaluating outcomes following open fractures of the distal radius. *J Hand Surg Am*. 2020;45(1):41-47. doi:10.1016/j.jhsa.2019.08.007.
6. Rozental TD, Beredjiklian PK, Steinberg DR, et al. Open fractures of the distal radius. *J Hand Surg Am*. 2002;27(1):77-85. doi:10.1053/jhsu.2002.30073.
7. Matos MA, Lima LG, de Oliveira LA. Predisposing factors for early infection in patients with open fractures and proposal for a risk score. *J Orthop Traumatol*. 2015;16(3):195-201. doi:10.1007/s10195-015-0345-z.
8. Gustilo RB, Anderson JT. Prevention of infection in the treatment of one thousand and twenty-five open fractures of long

bones: retrospective and prospective analyses. *J Bone Joint Surg Am*. 1976;58(4):453-458.
9. Yang EC, Eisler J. Treatment of isolated type I open fractures: is emergent operative debridement necessary? *Clin Orthop Relat Res*. 2003;410:289-294. doi:10.1097/01.blo.0000063795.32430.4c.
10. Yuan ZZ, Yang Z, Liu Q, et al. Complications following open reduction and internal fixation versus external fixation in treating unstable distal radius fractures: grading the evidence through a meta-analysis. *Orthop Traumatol Surg Res*. 2018;104(1):95-103. doi:10.1016/j.otsr.2017.08.020.
11. Li Y, Zhou Y, Zhang X, et al. Incidence of complications and secondary procedure following distal radius fractures treated by volar locking plate (VLP). *J Orthop Surg Res*. 2019;14:295. doi:10.1186/s13018-019-1344-1.
12. Kim JK, Park SD. Outcomes after volar plate fixation of low-grade open and closed distal radius fractures are similar. *Clin Orthop Relat Res*. 2013;471(6):2030-2035. doi:10.1007/s11999-013-2798-9.
13. Glueck DA, Charoglu CP, Lawton JN. Factors associated with infection following open distal radius fractures. *Hand (N Y)*. 2009;4(3):330-334. doi:10.1007/s11552-009-9173-z.