EDITOR'S CHOICE

Effect of Time-To-Surgery on Distal Radius Fracture Outcomes: A Systematic Review

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Purpose It remains unclear whether time-to-surgery for distal radius fractures affects clinical, functional, or radiographic outcomes or health care costs/use. This systematic review investigated the outcomes of early versus delayed surgery for closed, isolated distal radius fractures in adult patients.

Methods A comprehensive search of MEDLINE, Embase, and CINAHL databases was completed for all original case series, observational studies, and randomized controlled trials reporting clinical outcomes of both early and delayed surgically-treated distal radius fractures from database inception to July 01, 2022. A consistent threshold of two weeks was used to define early versus delayed treatment arms.

Results Nine studies, including 16 intervention arms and 1,189 patients (858 early, 331 delayed), were included. Mean age was 58 years (range, 33–76). At more than one year, the frequency-weighted mean Disabilities of the Arm, Shoulder, and Hand score was 4 in the early group (n = 208; range, 1–17) and 21 in the delayed group (n = 181; range, 4–27). Range of motion, grip strength, and radiographic outcomes were comparable. The pooled mean complication rate (7% vs 5%) and revision rate (3.6% vs 1%) were very low in both groups.

Conclusions A delay in time-to-surgery greater than two weeks for distal radius fractures may be associated with inferior patient-reported outcomes. Early surgery was associated with improved long-term Disabilities of the Arm, Shoulder, and Hand scores. On the basis of the available evidence, range of motion, grip strength, and radiographic outcomes are similar. The complication and revision rates were very low in both groups and comparable. *(J Hand Surg Am. 2023;48(5):435–443. Copyright © 2023 by the American Society for Surgery of the Hand. All rights reserved.)*

Type of study/level of evidence Therapeutic IV.

Key Words Delayed, outcomes, radius, surgery.

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Distal radius fractures (DRFs) are among the most common fractures of the upper extremity.[1] Morbidity associated with DRFs can be considerable, with potential for prolonged rehabilitation and poor functional outcomes.[1–3] In addition, management of DRFs contributes substantially to healthcare costs.[4,5]

In otherwise healthy populations, delays to surgery can result in adverse outcomes, such as extended pain, psychosocial stress, lost productivity, and wages. At our institution, the goal for ideal treatment of DRFs is to perform surgery within two weeks of injury to facilitate anatomic reduction before hard callus formation (peak at approximately 14 days),[6,7] reduce prolonged immobilization, and allow early functional rehabilitation.[8,9] Despite the lack of clear evidence, the consensus has been that fractures of the distal radius selected for surgery should ideally be treated within two weeks of injury.[10] These guidelines further suggest that surgical intervention should be performed within 72 hours of the decision to operate for fractures assessed on a delayed basis.[10]

Although there is no defined acceptable upper limit for delay in DRF surgery, there are several anticipated adverse effects, such as the development of stiffness, joint contractures, nerve compression, and cast-related complications.[8,9,11] Patients may also experience unnecessary discomfort from multiple reduction attempts by traction and manipulation alone.[12–14] Additionally, total time to fracture healing will be delayed because surgery may disrupt vascularity and established callus.[15] Finally, correcting larger deformities after partial healing is more technically demanding, but acceptable results have been reported in the literature despite these issues.[6]

This review aimed to assess the effect of time-to-surgery for DRFs on patient-reported, clinical, and radiographic outcomes. We hypothesize that patients with a delay to surgery greater than two weeks will have inferior long-term patient-reported and clinical outcomes. We anticipate that this effect will become less clinically relevant over time, with equivalent results obtained after one year. We also expect that patients with a delay in surgery will have increased complications and revisions.

MATERIALS AND METHODS

Search strategy

A comprehensive search of MEDLINE, EMBASE, and CINAHL was performed from database inception to July 01, 2022. MeSH and EMTREE headings and subheadings were used in various combinations and supplemented with free text keywords for "radius fractures" and "time delay" to maximize search sensitivity.

Study screening

This review was conducted in accordance with the Cochrane Handbook for Systematic Reviews of Interventions and the Preferred Reporting Items for Systematic Review and Meta-Analysis (PRISMA) statement. Articles were screened by two reviewers through an independent screening and extraction process. Any article with discordance between reviewers was included to ensure no relevant articles were omitted, and any disagreements were resolved by a third reviewer. A methodologic quality assessment was performed for each study using the Methodological Index for Nonrandomized Studies scale or the Detsky quality Assessment Scale.[16,17] The Methodological Index for Nonrandomized Studies scale is a validated tool for assessing the methodological quality of nonrandomized surgical studies. The Detsky[16] scale is validated to assess the methodologic quality of randomized orthopedic studies.

Assessment of study eligibility

All original case series, observational studies, and randomized control trials (RCTs) were included to compare any outcome of early versus delayed surgery for DRFs. Studies involving pediatric patients, open fractures, polytrauma, and animal and cadaveric models were excluded.

Definitions

Given that there is no established standard time-to-surgery for DRFs, early and delayed surgeries are variably defined in the literature. For our analysis, we used a consistent threshold of 2 weeks to identify intervention arms for comparison. This was on the basis of the time to hard callus formation, which peaks at approximately 14 days,[6,7] and in accordance with the British Society for Surgery of the Hand recommendations.[10] Intervention arms defined as early and delayed surgery not consistent with this threshold (ie, early surgery defined as less than three weeks or delayed surgery defined as more than one week) were excluded.

Early outcomes were defined at three months, and late outcomes at one year or greater. Major complications were defined as those for which revision surgery was offered or performed and complications outside the radius linked to the concomitant procedure. These included pain and infection at the donor graft site, such as with an iliac crest bone graft.

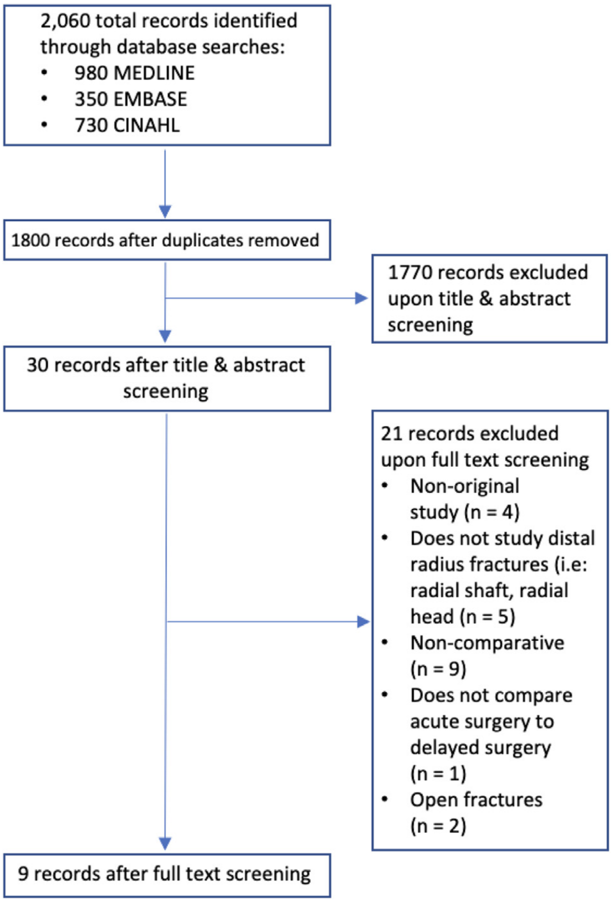

FIGURE 1: Preferred Reporting Items for Systematic Review and Meta-Analysis flow chart.

Patient-reported outcome measures included the Disabilities of the Arm, Shoulder, and Hand (DASH), the *Quick*DASH, or the Patient-Rated Wrist Evaluation. Generally, there is a high correlation between *Quick*DASH and DASH; therefore, results were pooled as an overall DASH score.[18] The reported minimal clinically important difference of the DASH score for nontraumatic conditions is 10, and the *Quick*DASH is 15. Of note, the minimal clinically important difference may vary in its sensitivity to change, and variable estimates of the minimal clinically important difference may exist for traumatic DRFs. However, these have not been well defined in the literature.[19–21]

Statistical analysis

Categorical data are presented as a count and/or percentage, whereas continuous data are presented as a mean. Outcome measures were pooled, and frequency-weighted means were calculated where applicable. Statistical significance was established using a nonparametric chi-square test. A P value of $<.05$ was defined as statistically significant.

RESULTS

A total of 2,060 unique studies were identified through MEDLINE, EMBASE, and CINAHL. Following title and abstract screening, 30 records were identified. A total of 9 studies, with 16 separate early or delayed groups ("treatment arms"), were included after full-text review (Fig. 1).[22–30] There was substantial agreement regarding article inclusion between the two independent reviewers, as indicated by a $\kappa > 0.60$ during title and abstract screening and full-text review.

The final list of included articles consisted of one RCT, three prospective cohort studies, and five retrospective cohort studies (Tables 1, 2). Of note, the one RCT consisted of patients who were randomized to undergo either immediate surgery with volar plating or initial nonoperative treatment with closed reduction. Outcomes of delayed surgery were analyzed in participants who showed early loss of alignment with closed reduction.

There were a total of 1,189 patients, with 858 receiving early surgical fixation and 331 receiving delayed treatment. In the included treatment arms, although early surgery was defined using a threshold of two weeks, time-to-surgery ranged from less than one day to less than two weeks. Similarly, delayed surgery ranged from greater than two weeks to greater than six weeks. The average patient age was 58 years (range, 33–76); 58% of patients were women (Tables 1, 2). There was no notable difference in the distribution of hand dominance (Table 2 in Appendix A, available online on the *Journal*'s website at www.jhandsurg.org).

Among the 8 observational studies, the mean Methodological Index for Nonrandomized Studies score was 19 out of a maximum of 24 (range, 14–20). For the RCT, the Detsky score was 18 out of a maximum of 21 (Tables 1, 2 in Appendix B, available online on the *Journal*'s website at www.jhandsurg.org).

All studies used the volar approach, except one study that did not specify the approach and another that used a dorsal approach in a small number of patients,[29] with 7% in the early group and 1% in the delayed group.[22] Notably, the early group in this study was excluded from our analysis because it did not meet the two-week threshold (early surgery was defined as less than four weeks).

Patient-reported outcomes

Patient-reported outcomes were reported with the DASH score in three studies,[23,25,27] the *Quick*DASH

TABLE 1. Characteristics of Included Studies

Study	Location	Study Design	Sex(M/F)	Sample Size (Early/Delayed)	Mean Age (Range), y	Mean Follow-Up, y
Bae et al[23]	South Korea	Prospective cohort	12/60	72 (48/24)	56 (52−62)	NR
Lee et al[22]	US	Retrospective cohort	88/83	171 (54/117)	46 (NR)	NR
MacFarlane et al[24]	UK	Retrospective cohort	NR	187 (173/14)	57 (16−93)	2.5
Sirniö et al[25]	Finland	Randomized controlled trial	NR	54 (38/16)	63 (50−82)	2.5
Weil et al[26]	Israel	Prospective cohort	50/65	115 (40/75)	53 (NR)	2
Yamashita et al[27]	Japan	Prospective cohort	0/106	106 (76/30)	67 (51−79)	3.4
Howard et al[28]	UK	Retrospective cohort	62/318	380 (346/34)	62 (18−86)	3.9
Ashdown et al[29]	UK	Retrospective cohort	66/92	158 (81/77)	57 (27−81)	2.75
Lee et al[30]	US	Retrospective cohort	30/45	75 (50/25)	49 (18−87)	324*

NR, not reported.
*Value is stated in days.

in two studies,[22,26] and with the Patient-Rated Wrist Evaluation in two studies (Table 2).[24,28] Data presented in the individual studies lacked sufficient details regarding measures of spread and variance. As such, pooled analysis was not performed; instead, frequency-weighted means were calculated.

Six intervention arms reported an early DASH and/or *Quick*DASH score at three months (n = 232); five were in the early group (n = 208), and one was in the delayed group (n = 24).[22,23,25−27] The frequency-weighted mean DASH score was 12 (range, 5−20) in the early group and 23 (not reported [NR]) in the delayed treatment arm (Figs. 2, 3).

Eight intervention arms reported a late DASH and/or *Quick*DASH score for over one year (n = 389); five were in the early group (n = 208), and three were in the delayed group (n = 181).[22,23,25−27] The frequency-weighted mean DASH score was 4 (range, 1−17) in the early group and 21 (range, 4−27) in the delayed group.

Range of motion

Six intervention arms reported range of motion outcomes at three-months and over one-year time points (n = 232); five in the early group (n = 208) and one in the delayed group (n = 24).[23,25,27] Data presented in the individual studies lacked sufficient details regarding measures of spread or variance. As such, pooled analysis was not performed, and frequency-weighted means were calculated.

At three months, the pooled mean flexion-extension arc was 118° (range, 87−141°) in the early group and 82° in the delayed treatment arm. For more than one year, the pooled mean flexion-extension arc was 124° (range, 102−141°) in the early group and 109° (NR) in the delayed treatment arm (Table 3). Overall, there was a 15° higher range in the flexion-extension arc after one year in the early surgery group.

At three months, the pooled mean total rotation arc was 169° (range, 155−180°) in the early group and 180° (NR) in the delayed treatment arm. For more than one year, the pooled mean total rotation arc was 175° (range, 169−180°) in the early group and 180° (NR) in the delayed treatment arm (Table 3).

Grip strength

Grip strength was reported in six intervention arms (n = 232); five were in the early group (n = 208), and one was in the delayed group (n = 24).[23,25,27] Four treatment arms presented results as a percentage of the contralateral side. Two treatment arms presented grip strength as an absolute value (in kilograms); both these studies were in the early treatment group, and therefore, excluded from the analysis.[25] As mentioned above, pooled analysis could not be performed, and frequency-weighted means were calculated.

At three months, the pooled mean grip strength was 74% (range, 65% to 81%) in the early group (n = 154) and 58% (range, 40% to 71%) in the delayed treatment

TABLE 2. Characteristics of Included Treatment Arms

Study	Time to Early Surgery, wks	Short-Term Clinical Outcome DASH Scores (3 mos)	Long-Term Clinical Outcome Scores (>1 y)	Complication Rate	Revision Rate
Bae et al[23]	<2	19	3.3†	0/48	NR
Bae et al[23]	2–6	23	4.3†	0/24	1/54
Lee et al[22]	>4	Not Reported	22‡	4/117	0/117
MacFarlane et al[24]	<2	Not Reported	NR† 12.2§	Unclear	Unclear
MacFarlane et al[24]	>2	Not Reported	NR† 26§	Unclear	Unclear
Sirniö et al[25]	<1	10	7 (2 ys)†	3/38	1/38
Sirniö et al[25]	1–2	20	17 (2 ys)†	Unclear	Unclear
Weil et al[26]	>3	Not Reported	27.1‡	3/75	1/75
Yamashita et al[27]	<1*	4.9	1.1 (1 y)†	2/76	1/76
Yamashita et al[27]	1–2	13.7	4.7 (1 y)†	4/30	1/30
Howard et al[28]	<2	Not Reported	Not Reported† 5.5§	Unclear	15/346
Howard et al[28]	>2	Not Reported	Not Reported† 8.8§	Unclear	1/34
Ashdown et al[29]	<2	Not Reported	Not Reported† Not Reported§	Unclear	Unclear
Ashdown et al[29]	>2	Not Reported	Not Reported† Not Reported§	Unclear	Unclear
Lee et al[30]	<2	Not Reported	Not Reported†	5/50	Unclear
Lee et al[30]	>2	Not Reported	Not Reported†	3/25	Unclear

DASH, Disabilities of the Arm, Shoulder, and Hand; N/A, not applicable.
*Day.
†DASH.
‡*Quick*DASH.
§Patient-Related Wrist Evaluation.

arm (n = 24). For over one year, the pooled mean grip strength was 88% in the early group (n = 48) and 84% in the delayed treatment arm (n = 24).

Radiographic outcomes

Radiographic outcomes were reported in 10 treatment arms (n = 464); 6 were in the early group (n = 258),[23,25,27,30] and 4 were in the delayed group (n = 206).[22,23,26,30] As mentioned above, pooled analysis could not be performed, and frequency-weighted means were calculated. The pooled mean radial inclination was 23.4° versus 22.1°, volar angulation was 7.6° versus 5.3°, and ulnar variance was 0.6 mm versus 0.2 mm in the early and delayed groups, respectively (Table 4).

Complications

Complications were reported in seven treatment arms. There were 14 complications (7%) in the early group (n = 194) and 9 complications (5%) in the delayed group (n = 182).The revision rate in the early group was 3.6% (4 intervention arms, 18 of 490), and 1% in the delayed group (2 intervention arms, 2 of 191). Revisions included reintervention for prominent hardware, repair of tendon rupture, carpal tunnel release, and bone grafting for postreduction bone voids. Of note, in one study, two patients in the delayed surgery group declined revision.[26]

The reported complications for each group are summarized in Table 5.

DISCUSSION

Our findings demonstrate improved DASH scores in the short-term (three months) and long-term (greater than one year) in the early surgery group compared with the delayed group using a two-week threshold. The difference in frequency-weighted mean DASH score between early and delayed groups was 11 at 3

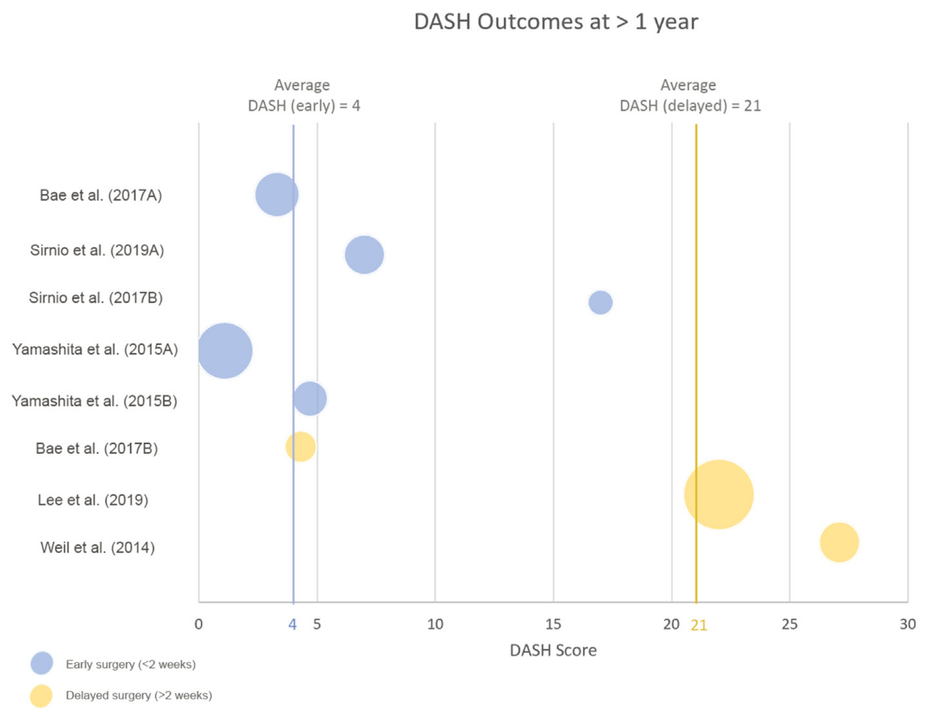

FIGURE 2: Disabilities of the Arm, Shoulder, and Hand scores at more than one year. Size of the data point represents the sample size.

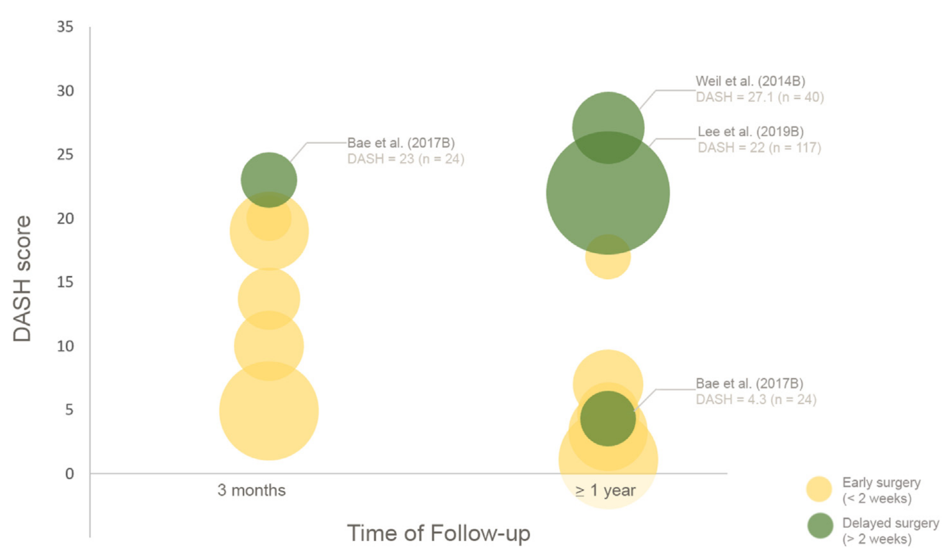

FIGURE 3: Comparison of DASH scores for early and delayed surgery at three months and greater than one year. Size of the data point represents the sample size.

months and 17 at >1 year. The results favored the early group at both time points and the magnitude of the difference is probably clinically relevant, particularly at greater than one year (Figs. 2, 3). Ashdown et al[29] showed that although the patient-reported outcomes did not present a statistically significant functional limitation between groups, there was a clear relationship between stiffness of the small joints of the fingers and surgery beyond two weeks.

Whether a true difference exists between early and delayed surgery regarding wrist motion and grip strength remains unclear. The flexion-extension arc at more than one year was 15° higher in the early surgery group compared with the delayed group; however, limitations in conducting statistical analysis precludes any definitive conclusion on the basis of currently available evidence. This may represent a clinically relevant difference and warrants further

TABLE 3. Frequency-Weighted Mean Postoperative Range of Motion

Study	Early		Delayed	
	3 Mos	1 Y	3 Mos	1 Y
Flexion-extension arc (°)	118	124	82	109
Forearm rotation arc (°)	169	175	180	180
Grip strength (% of baseline)	74	88	58	84

TABLE 4. Frequency-Weighted Mean Postoperative Radiographic Outcomes

Study	Early	Delayed
Radial inclination (°)	23.4	22.1
Volar angulation (°)	7.6	5.3
Ulnar variance (mm)	0.6	0.2

investigation. As for the rotational range of motion, an absolute difference of 5° at one year likely does not represent a clinically relevant difference. On the basis of the available data, outcomes for grip strength and radiographic parameters did not represent a clinically relevant difference.

The complication and reoperation rates in this review were very low and comparable. Characterizing the complications associated with early and delayed surgery would have added value in informing clinical practice; however, due to rarity of complications in this review, we are unable to draw any conclusions.

Hooper et al[31] demonstrated that performing surgery within seven days of the fracture event had lower surgeon-perceived difficulty and led to better surgeon-perceived reduction quality following fixation, regardless of the technique used. This article supports early intervention given that better surgeon-perceived quality of reduction may affect the decision to initiate earlier wrist and forearm range of motion. This could positively affect long-term mobility.

The authors recognize several limitations of this study. First, the definition of early versus delayed surgery varied considerably between studies. We attempted to standardize this by identifying treatment arms within our predefined threshold of two weeks. Another limitation was the major difference in sample size at the three-month follow-up for clinical parameters (functional outcome scores, range of motion, and grip strength), which limited early outcome assessment (208 early vs 24 delayed patients). However, sample sizes from more than one year were more comparable (208 early vs 181 delayed patients).

Several outcome scores were reported in the included studies, including the DASH, *Quick*DASH, and Patient-Rated Wrist Evaluation systems. This review treated the DASH and the *Quick*DASH as comparable metrics, which may have introduced some imprecision. However, a study by Gummesson et al[32] found that cross-sectional and test-retest reliability of the DASH and *Quick*DASH scores were similar, including good precision in upper extremity disorders. Similarly, a study by Niekel et al[33] suggested a high correlation between the two-scoring metrics, with slightly higher scores expected for the *Quick*DASH. Tsang et al[34] found that *Quick*DASH scored higher than DASH scores by 3.8 and 1.2 points at baseline and one-year follow-up, respectively. Of note, on the basis of the findings of Tsang et al,[34] the *Quick*DASH appears to approximate the DASH score more closely at a one-year follow-up, and the results of our study showed a larger difference in DASH scores at more than one-year follow-up. As such, the magnitude of difference demonstrated in this review would not be attributable to this alone and are still representative of the overall relative patient-reported outcomes. Further limitations include potential discrepancies in how these metrics were measured and reported. Specifically, some studies reported very low DASH scores compared with the population normative values for this scale, which may reflect measurement error or methodologic flaws. In addition, grip strength was examined as an outcome. However, individual studies did not report grip strength on the basis of hand dominance. This precluded a statistical correction to account for stronger grip strength in the dominant hand.

Finally, the current study did not attempt to explain factors related to surgical delay. The authors recognize that early surgery may not always be feasible within a two-week timeframe due to several contributing factors, such as diagnostic uncertainty, surgeon expertise, failure of initial treatment, and preoperative optimization. Institutional factors also play an important role, particularly as they pertain to costs and availability of operating room time in a resource-limited system.

Delay in time-to-surgery greater than two weeks for DRFs may be associated with inferior functional outcomes. Early surgery was associated with improved short- and long-term DASH scores. On the basis of the available evidence, range of motion, grip strength, and radiographic outcomes were similar.

TABLE 5. Summary of Minor and Major Complications in the Early Versus Delayed Surgery Groups

Treatment Group	Minor Complications	Major Complications
Early	- Flexor tenosynovitis (n = 1) - Posttraumatic radiocarpal arthritis (n = 1) - Superficial infection (n = 1) - Numbness at the palmar branch of the median nerve area (n = 1) - Complex regional pain syndrome (n = 2)	- Carpal tunnel syndrome; requiring release (n = 1) - Rupture of the extensor pollicis longus tendon; requiring reconstruction (n = 1) - Backing out of proximal cortical screw; requiring revision (n = 1) - Loss of fixation/malunion (n = 3)
Delayed	- Superficial infection (n = 3)	- Prominent hardware due to joint subsidence; requiring revision (n = 1) - Tendon irritation due to a radially prominent plate; offered hardware removal (n = 1) - Sensory neuropathy; offered neurolysis (n = 1) - Postreduction bone void; requiring iliac bone grafting (n = 4) Deep infection (n = 1)

The complication and revision rates in both groups were very low and comparable.

REFERENCES

1. Nellans KW, Kowalski E, Chung KC. The epidemiology of distal radius fractures. *Hand Clin*. 2012;28(2):113−125.
2. MacDermid JC, Donner A, Richards RS, Roth JH. Patient versus injury factors as predictors of pain and disability six months after a distal radius fracture. *J Clin Epidemiol*. 2002;55(9):849−854.
3. MacDermid JC, Roth JH, Richards RS. Pain and disability reported in the year following a distal radius fracture: a cohort study. *BMC Musculoskelet Disord*. 2003;4:24.
4. Dzaja I, MacDermid JC, Roth J, Grewal R. Functional outcomes and cost estimation for extra-articular and simple intra-articular distal radius fractures treated with open reduction and internal fixation versus closed reduction and percutaneous Kirschner wire fixation. *Can J Surg*. 2013;56(6):378−384.
5. Swart E, Tulipan J, Rosenwasser MP. How should the treatment costs of distal radius fractures be measured? *Am J Orthop (Belle Mead NJ)*. 2017;46(1):E54−E59.
6. Wijffels MME, Orbay JL, Indriago I, Ring D. The extended flexor carpi radialis approach for partially healed malaligned fractures of the distal radius. *Injury*. 2012;43(7):1204−1208.
7. Marsell R, Einhorn TA. The biology of fracture healing. *Injury*. 2011;42(6):551−555.
8. Kuo LC, Yang TH, Hsu YY, et al. Is progressive early digit mobilization intervention beneficial for patients with external fixation of distal radius fracture? A pilot randomized controlled trial. *Clin Rehabil*. 2013;27(11):983−993.
9. Schott N, Korbus H. Preventing functional loss during immobilization after osteoporotic wrist fractures in elderly patients: a randomized clinical trial. *BMC Musculoskelet Disord*. 2014;15:287.
10. British Orthopaedic Association, Boast - The management of distal radial fractures. Accessed August 27, 2022. https://www.boa.ac.uk/static/eca9b368-6c1d-4a44-b98de7cfc9247273/5c46835b-7d0f-40c4-89112dd5beddcda7/boast%20-%20the%20management%20of%20distal%20radial%20fractures.pdf
11. Cantero-Téllez R, Orza SG, Bishop MD, Berjano P, Villafañe JH. Duration of wrist immobilization is associated with shoulder pain in patients with after wrist immobilization: an observational study. *J Exerc Rehabil*. 2018;14(4):694−698.
12. Schermann H, Kadar A, Dolkart O, Atlan F, Rosenblatt Y, Pritsch T. Repeated closed reduction attempts of distal radius fractures in the emergency department. *Arch Orthop Trauma Surg*. 2018;138(4):591−596.
13. Beumer A, McQueen MM. Fractures of the distal radius in low-demand elderly patients: closed reduction of no value in 53 of 60 wrists. *Acta Orthop Scand*. 2003;74(1):98−100.
14. Khalid N, Algarni AD. Loss of position after initial manipulation of distal radius fractures in elderly. *Saudi J Sports Med*. 2017;17(2):97.
15. Freeland AE, Luber KT. Biomechanics and biology of plate fixation of distal radius fractures. *Hand Clin*. 2005;21(3):329−339.
16. Detsky AS, Naylor CD, O'Rourke K, McGeer AJ, L'Abbé KA. Incorporating variations in the quality of individual randomized trials into meta-analysis. *J Clin Epidemiol*. 1992;45(3):255−265.
17. Slim K, Nini E, Forestier D, Kwiatkowski F, Panis Y, Chipponi J. Methodological index for non-randomized studies (minors): development and validation of a new instrument. *ANZ J Surg*. 2003;73(9):712−716.
18. Franchignoni F, Vercelli S, Giordano A, Sartorio F, Bravini E, Ferriero G. Minimal clinically important difference of the disabilities of the arm, shoulder and hand outcome measure (DASH) and its shortened version (QuickDASH). *J Orthop Sports Phys Ther*. 2014;44(1):30−39.
19. Mulders MAM, Walenkamp MMJ, van Dieren S, Goslings JC, Schep NWL, VIPER Trial Collaborators. Volar plate fixation versus plaster immobilization in acceptably reduced extra-articular distal radial fractures: A multicenter randomized controlled Trial. *J Bone Joint Surg Am*. 2019;101(9):787−796.
20. MacDermid JC, Turgeon T, Richards RS, Beadle M, Roth JH. Patient rating of wrist pain and disability: a reliable and valid measurement tool. *J Orthop Trauma*. 1998;12(8):577−586.
21. Sorensen AA, Howard D, Tan WH, Ketchersid J, Calfee RP. Minimal clinically important differences of 3 patient-rated outcomes instruments. *J Hand Surg Am*. 2013;38(4):641−649.
22. Lee C, Pereira C, Zoller S, et al. Feasibility and reliability of open reduction internal fixation in delayed distal radius fracture management. *J Hand Surg Glob Online*. 2019;1(3):138−143.
23. Bae JY, Yoon JO, Choi SW, Kim JK. Comparison of outcomes between partially healed and acute metaphyseally malaligned distal radial fracture treated by palmar locking plate fixation. *J Orthop Sci*. 2017;22(6):1049−1053.
24. MacFarlane RJ, Miller D, Wilson L, et al. Functional outcome and complications at 2.5 years following volar locking plate fixation of distal radius fractures. *J Hand Microsurg*. 2015;7(1):18−24.
25. Sirniö K, Leppilahti J, Ohtonen P, Flinkkilä T. Early palmar plate fixation of distal radius fractures may benefit patients aged 50 years or older: a randomized trial comparing 2 different treatment protocols. *Acta Orthop*. 2019;90(2):123−128.

26. Weil YA, Mosheiff R, Firman S, Liebergall M, Khoury A. Outcome of delayed primary internal fixation of distal radius fractures: a comparative study. *Injury*. 2014;45(6):960−964.
27. Yamashita K, Zenke Y, Sakai A, Oshige T, Moritani S, Maehara T. Comparison of functional outcome between early and delayed internal fixation using volar locking plate for distal radius fractures. *J UOEH*. 2015;37(2):111−119.
28. Howard M, Curtis A, Everett S, Harries L, Donaldson O, Sheridan B. Does a delay in surgery for distal radial fractures affect patient outcome? *J Hand Surg Eur Vol*. 2021;46(1):69−74.
29. Ashdown T, Morris J, Mckeon S, Clough OT, Little M, Anakwe RE. Surgical fixation of fractures of the distal radius within 2 weeks reduces postoperative finger stiffness. *J Hand Surg Eur*. 2021;46(1):64−68.
30. Lee SJ, Stenquist DS, Collins JE, et al. Radiographic outcomes and complications of delayed fixation of distal radius fractures. *Hand (N Y)*. 2022;17(4):748−753.
31. Hooper RC, Zhou N, Wang L, Shauver MJ, Chung KC. Wrist and Radius Injury Surgical Trial Group. An analysis of the impact of timing and technique on outcomes after surgery for distal radius fractures: the Wrist and Radius Injury Surgical Trial Collaborative Study. *Plast Reconstr Surg*. 2021;148(5):1053−1062.
32. Gummesson C, Ward MM, Atroshi I. The shortened disabilities of the arm, shoulder and hand questionnaire (QuickDASH): validity and reliability based on responses within the full-length DASH. *BMC Musculoskelet Disord*. 2006;7:44.
33. Niekel MC, Lindenhovius ALC, Watson JB, Vranceanu AM, Ring D. Correlation of DASH and QuickDASH with measures of psychological distress. *J Hand Surg Am*. 2009;34(8):1499−1505.
34. Tsang P, Walton D, Grewal R, MacDermid J. Validation of the QuickDASH and DASH in patients with distal radius fractures through agreement analysis. *Arch Phys Med Rehabil*. 2017;98(6): 1217−1222.e1.