

Intra-articular fractures of the distal radius in high demand elderly patients: techniques and timing of treatment

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SUMMARY

Fractures of the distal radius are frequent in the people older than 65 years, especially in women. Contrary to past assumptions of low activity levels among the elderly, there is a growing segment of this population that demand higher functional capabilities. This shift in demographics has led to a re-evaluation and evolution of treatment strategies. The aim of our study is to perform a review of the literature to better identify and define the optimal treatment for intra-articular distal radius fracture in active people 65 years old or more. The selection of papers included in the review was conducted on PubMed and Google Scholar databases: 10 studies were included. Current evidence demonstrates that surgical treatment provides measurable benefits in quicker return to daily activities and fewer complications for high demand patients older than 65 years than conservative treatment. However, this does not always correspond to clinical results and satisfaction of the patient. According to the literature, the treatment plan should be personalized for every patient taking into account the features of the fracture, functional requests, daily activities and possible comorbidities.

Key words: distal radius fracture, active elderly population, distal radius fracture treatment

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Introduction

Fractures of distal radius are the most common fractures of the upper limb. They present a bimodal distribution with a peak incidence in people between 6 to 10 years old and a second peak in the elderly, usually in people older than 65 years¹⁻⁵. The first treatment ever reported for this kind of fracture was recorded in a 5000-year-old papyrus in Egypt, called the Edwin Smith papyrus⁴⁻¹⁰.

Since then, the management of fracture has evolved and many different surgical devices have been used. These technical advances have been useful especially in the treatment of active elderly patients.

Unlike earlier assumptions of low demand among the elderly, an increasing number of individuals aged 65 and above now present with higher functional requirements. Consequently, there has been a shift in the indications for surgery to meet these evolving demands.

In the elderly and osteoporotic patient, simple falls with outstretched hand can cause a distal radius fracture that involves the articular surface (Figs. 1-2). In fact, distal radius fractures in the elderly can be a result of underlying abnormalities in bone metabolism and they appear earlier than hip and vertebral fractures¹¹.

Post-menopausal women most commonly develop a distal radius fracture after a simple fall¹². While in the past most intra-articular fractures were treated conservatively



Figures 1-2. Woman 78 years old, falling at home.

actively because elderly patients were considered low demand, the older but high demand population continues to grow and thus treatment should be personalized according to their daily activities and requests.

Many surgical and conservative management strategies exist to treat distal radius fractures: closed reduction and plaster casting, Kirschner-wire stabilization, external fixation, and open reduction and internal fixation (ORIF) ¹²⁻¹⁵.

Nowadays, conservative management is still an option, being the most common treatment reported. Plaster casting under the elbow is the treatment of choice for stable fractures ¹⁶.

Unstable fractures can be assessed by the criteria described by la Fontaine in 1989 and intraarticular involvement and being older than 65 years are still valid ⁷. While in sedentary patients with low demands, functional outcomes are good despite the presence of residual deformities ¹⁷, high demand patients request a more accurate treatment strategy to return to previous activities of daily living. The aim of our study is to perform a review of the literature to better identify and define the optimal treatment for intra-articular distal radius fracture in active people 65 years old or more.

Materials and methods

The process of selecting papers for the review was carried out using the PubMed database. The authors utilized combinations of the terms "distal radius," "treatment," "elderly," and "active," linking them with the Boolean operator "AND" to refine the search results. In all, 679 results were founded. Only papers published in English or Italian after 1980 were considered eligible for inclusion. Studies involving patients under 65 years old were not considered. Additionally, studies comparing outcomes between older adults and young adults were also excluded. Case reports and reviews were excluded from the review process.

Ultimately, a total of 11 studies met the inclusion criteria and were included in the analysis, as summarized in Table I.

The objective of our study is to conduct a comprehensive literature review to better ascertain and define the optimal treatment approach for intra-articular distal radius fractures in active individuals aged 65 years or older.

Discussion

Distal radius fractures (ADRFs) are the second most prevalent fracture type in the elderly population, defined as individuals aged 65 years and above. Furthermore, the incidence of ADRFs is on the rise, presenting a growing public health concern. Notable risk factors associated with ADRFs include female gender, Caucasian ethnicity, osteoporosis, hypovitaminosis D, and heightened activity levels. Despite advancements in treatment modalities, the optimal management strategy for intra-articular ADRFs in the elderly remains elusive.

Conservative management remains the primary approach for intra-articular ADRFs, particularly in cases of non-displaced fractures. This entails immobilization using a wrist cast or splint under the elbow, coupled with one or more serial monitoring visits and X-Rays for 4 weeks. This approach aims to facilitate adequate healing while minimizing the risk of complications. There is no definitive agreement on the factors that predict instability concerning secondary displacement in distal radius fractures. However, increasing age, particularly beyond 60 years, and the presence of dorsal comminution are the most commonly reported and acknowledged predictors ¹⁸.

When a distal radius fracture is displaced but can be reduced, the procedure involves closed reduction, typically performed under a hematoma block with local anesthesia within the emergency department. However, there is no universally accepted consensus on the best technique and anesthetic approach for closed reduction of distal radius fractures, as various methods appear to be equally effective. Furthermore, the choice of reduction technique does not seem to impact radiological outcomes ¹⁸.

Subsequent to successful reduction, the patient undergoes immobilization via a short-arm cast, followed by post-reduction

Table I. Features of the studies included.

First author	# of Patients	Intervention	Age	Follow-up (months)	Outcome measures	Correlation: X-Rays/clinical outcomes
Park (2021) ²²	167	Conservative		84	DASH, RA	No
Jaremko (2007) ³²	74	Conservative	69	6	DASH, RA	No
Chan (2014) ²³	75	Conservative 35	74	12	GS, complications, ROM, DASH, RA	Yes
		ORIF 40				
Moutinot (2022) ²⁸	158	ORIF	89	3	Complications, RA	Yes
Südwow (2022) ³¹	66	Conservative 33	77	36	GS, complications, ROM, DASH, PRWE, RA	No
		ORIF 33				
Földhazy (2010) ²⁰	51	Conservative 22	71	12	GS, complications, ROM, RA	No
		External Fixator 29				
Tahir (2021) ³⁰	159	Conservative 72	81	12	GS, complications, ROM, DASH, PRWE, RA	Yes
		ORIF 87				
Martinez (2018) ²⁷	97	Conservative 47	70	24	GS, complications, ROM, DASH, PRWE, RA	Yes
		ORIF 50	67			
Bartl (2014) ²⁴	149	Conservative	74	12	Complications, ROM, DASH, RA	No
		ORIF	74			
Aktekin (2010) ²¹	46	External fixator 22	73	27	GS, complications, ROM, DASH, VAS, RA	No
		Conservative 24	76			
Cheng (2021) ³⁶	87	ORIF 87	66	12	ROM, Complications, VAS, RA	No
Lawson (2021) ³⁹	300	ORIF 81 Conservative 85	71	12	Complications DASH, PRWE	No

GS: grip strength; ROM: range of motion; RA: radiographic assessment; PRWE: patient-rated wrist evaluation; DASH: disabilities of the arm, shoulder and hand.

radiographs to evaluate the alignment and adequacy of reduction. It is imperative to assess the quality of the skin before undertaking the reduction maneuver, as elderly individuals are more susceptible to skin tears compared to their younger counterparts.

Following reduction, if deemed satisfactory and the articular fracture fragments are deemed stable ^{4,19}, repeat radiographs are obtained approximately one week later to reassess the adequacy and maintenance of the reduction achieved. This protocol ensures meticulous monitoring and evaluation of the patient's progress towards optimal healing and alignment.

There is a notable scarcity of literature assessing surgical outcomes in elderly patients, particularly with regards to accommodating their functional requirements. As previously noted by La Fontaine ⁷, elderly individuals with osteoporosis often

present with weak cortices that may not adequately support alignment via closed reduction, particularly in cases of intra-articular fractures. This consideration underscores the potential indication for surgical intervention, particularly among active patients who heavily rely on wrist function. Mackenney et al. have also identified key predictive criteria for ADRF outcomes, including age, metaphyseal comminution, ulnar variance, and patient independence, which have been demonstrated to be significant predictors of radiographic malunion and instability ^{5,20}. To cater to the needs of active elderly patients and circumvent the need for open procedures while mitigating reliance on bone quality, some researchers have proposed the utilization of external fixators. However, studies such as that by Földhazy ²¹ suggest that primary external fixation for displaced distal radial fractures in patients aged 60-85 years yields positive effects

primarily on radiographic outcomes without discernible clinical benefits compared to cast treatment. Similarly, Aktekin et al.²² observed no significant clinical or radiological differences between closed reduction and casting *versus* external fixator application for distal radius fractures in patients aged 65 years and older.

The introduction of locking plates and screws has notably enhanced surgical outcomes by circumventing the necessity to rely solely on bone quality. However, this approach still carries inherent surgical risks, necessitating a thorough analysis of the risk-benefit profile tailored to the functional requirements of the individual patient.

Nevertheless, the predictive value of radiographic alignment on functional outcomes remains ambiguous. For instance, in a study by Park et al.²³, 30% of patients developed malunion following conservative treatment. Despite this, there was no statistically significant difference in the pain numeric rating scale scores between patients with malunion and those with acceptable alignment (0.8 *vs* 0.4, respectively). Similarly, the QuickDASH scores were higher among patients with malunion compared to those with adequate alignment (14.9 *vs* 11.1, respectively); however, this discrepancy did not have clinical significance. These findings underscore the complex interplay between radiographic alignment and functional outcomes, warranting further investigation.

Furthermore, as indicated by Chan²⁴, elderly patients with an active lifestyle who underwent surgical intervention demonstrated earlier restoration of wrist motion and grip strength compared to those managed conservatively. However, this disparity failed to reach statistical significance after a 6-month follow-up period.

In a separate study by Bartl et al., outcomes related to mobility, functionality, and quality of life at the 12-month mark were marginally and inconsistently superior for individuals treated with volar angle-stable plate osteosynthesis compared to those who underwent closed reduction and casting for intra-articular distal radius fractures. Despite these findings, Bartl et al. maintained that nonsurgical management remains a valid treatment option for elderly patients, even in an era marked by the widespread utilization of locking plate fixation techniques²⁵.

Limited disparities in functional outcomes between non-operative and surgical management approaches have been observed in osteoporotic patients, as reported in previous studies^{9,26,27}. However, some patients may opt for corrective osteotomies to address symptomatic malunions, particularly those with high functional demands.

Conversely, Martinez et al. documented superior outcomes in terms of Patient-Rated Wrist Evaluation (PRWE), Disabilities of the Arm, Shoulder, and Hand (DASH) scores, and overall functional and quality of life scores among patients treated surgically compared to those managed conservatively. They attributed the high incidence of secondary displacement observed in the conservative treatment group among elderly pa-

tients. Additionally, Martinez et al. highlighted the significance of restoring radial inclination and ulnar variance in influencing outcomes, with the PRWE score showing a significant correlation with radial inclination ($p = 0.02$) and ulnar variance²⁸.

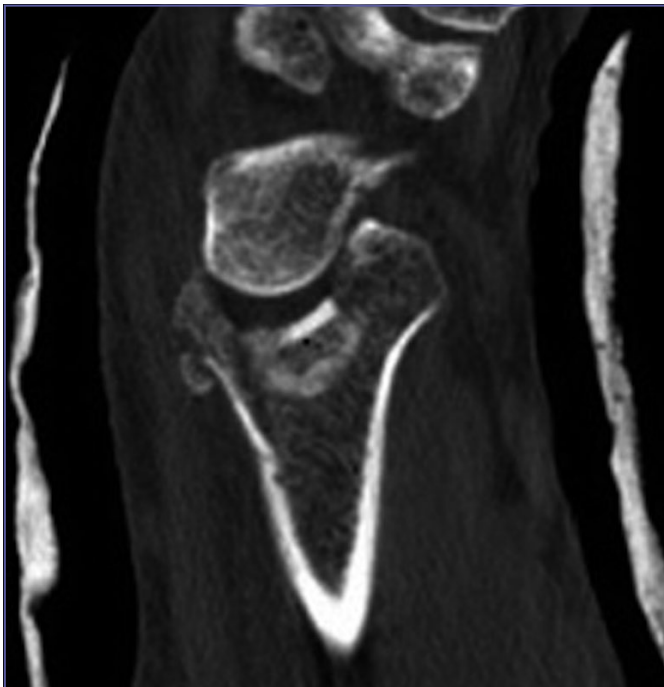
Complications have been documented following both surgical and conservative treatments for distal radius fractures^{13,29}. These complications encompass a range of issues such as nerve compression, complex regional pain syndrome (CRPS), tendon ruptures, loss of reduction, malunion, and infections. Notably, elderly patients are more prone to experiencing loss of reduction and malunion following conservative treatment compared to younger adults. However, despite these complications, functional deficits observed in long-term follow-up were relatively minor when compared to alternative treatment methods. Young et al. noted a discrepancy between radiographic and functional outcomes, with only 24% of cases demonstrating excellent radiological results, yet 88% had excellent functional outcomes despite poor radiographic findings³⁰.

Tendon complications arising from the treatment of distal radius fractures encompass a spectrum ranging from tenosynovitis to tendon ruptures. Interestingly, in elderly patients, the incidence of tenosynovitis and tendon ruptures for both extensor and flexor tendons appears comparable to that observed in younger patients. This suggests that age-related tendon vulnerability may not be the primary factor contributing to these complications. Instead, improper application of osteosynthesis devices may play a more significant role in their occurrence.

Infections are an uncommon occurrence in the context of distal radius fractures, particularly among elderly patients. The most frequently encountered minor complication involves superficial infection of Kirschner wires and external fixator pins. Such infections can typically be managed with antibiotic therapy and by promptly removing the affected pins and wires. Instances of deep infection leading to osteomyelitis are exceedingly rare in cases treated percutaneously, whether through external fixators or open reduction and internal fixation (ORIF), regardless of the patient's age.

In a randomized trial conducted by Tahir et al., complication rates were found to be higher among elderly patients treated with immobilization compared to those managed surgically. Specifically, the study reported 10 cases of malunion out of 72 patients treated with cast immobilization, as opposed to only 2 cases among the 87 patients treated with a volar locking plate. However, despite these differences, no disparities were observed in Patient-Reported Outcome Measures (PROMs) at one-year follow-up between distal radius fractures managed with anterior locking plates versus those managed with cast immobilization in patients aged over 75 years³¹.

Conversely, grip strength, range of motion, and clinical scores (including DASH and PRWE) exhibited no significant differences based on the treatment modality in 9 of 10 studies in our analysis^{21,32-34}. Notably, a pivotal finding was outlined



Figures 3-6. Man 70 years old, motorcycle accident.

in the study by Jaremko ³³, where the author determined that self-reported outcomes among older adults with conservatively managed wrist fractures were not contingent upon the “acceptability” of radiographic fracture reduction. Despite the high incidence of displaced DRFs and the substantial possible implications of suboptimal management, there is

no high-level scientific evidence available regarding the best treatment method for elderly patients. Typically, treatment depends on the type and severity of the DRF, the patient’s age and general health, surgical indication, and the surgeon’s technical performance. In recent decades, there has been an increase in the use of internal fixation with a volar plate. The DRF guide-



Figures 7-8. Three years follow-up.

lines supported by the AAOS recommend surgical treatment for fractures with instability criteria such as post-reduction radial shortening of over 3 mm, dorsal tilt of over 10 degrees, or intra-articular displacement or step-off of over 2 mm³⁰. These guidelines are supplemented by the Appropriate Use Criteria, which consider fracture type, mechanism of injury, patient activity level, health status, and other injuries³⁵. Unfortunately, these guidelines do not provide clear recommendations for managing elderly patients.

Our findings align with previous systematic reviews³⁶ showing that, despite worse radiographic outcomes with cast immobilization, differences in functional outcomes are not clinically significant compared to surgical treatment. In elderly patients, the evidence linking radiological reduction criteria and functional outcomes is still inconclusive. A recent study found that postoperative ulnar-positive deformity is the most significant risk factor for radial collapse after open reduction and internal fixation with a volar plate. However, there were no statistically significant differences in range of motion, grip strength, and pain in elderly patients³⁷. The lack of association between radiographic and

functional outcomes may be due to lower functional demand in the upper limbs with aging. Consequently, some authors propose categorizing elderly patients into low- or high-demand groups to improve therapeutic management³⁷. Contrary to anatomic or radiological parameters, certain patient-related characteristics, such as physical activity level, pain-related anxiety, catastrophizing related to pain, and severity of acute pain, are strongly related to functional outcomes^{39,40}.

Regarding the timing of the surgery, Campbell found a higher reoperation rate in patients who underwent delayed fixation compared to those who had early fixation. However, the timing of volar plate fixation was not associated with differences in postoperative QuickDASH scores and operative time⁴¹. Moreover, even if delayed surgical intervention for distal radius fractures is sometimes considered more challenging by the surgeon⁴², current evidence shows minimal clinical differences in motion and overall function at long-term follow-up. According to a recent article by Sirniö, DASH score, wrist flexion and ulnar deviation at 24 months were better in patients older than 50 years treated with early surgery, but differences in ROM and grip strength were not relevant^{43,44}. Delayed operation in cases of secondary displacement after initial nonoperative treatment did not provide results as good as early surgery in terms of the DASH score. Therefore, the decision between surgical and nonoperative treatment should be made early, and delayed surgery should be avoided for secondary displacement of DRFs in elderly patients. Our study has some limitations: there is some statistical heterogeneity between the studies analyzed. Possible causes of heterogeneity may be different fracture types, numerous treatment strategies and approaches, complications and comorbidities frequently encountered in geriatric population. On the other hand, it is a comprehensive literature review that helps surgeons to tailor treatment to the unique needs of each patient.

Conclusions

Distal radius fractures are the most common upper extremity fractures in the elderly population, with their incidence expected to rise, leading to increased healthcare costs. Conservative treatment has been associated with radiographic malunion, cosmetic deformity, and reduced grip strength. However, numerous studies have shown that despite these issues, functional outcomes such as DASH and PRWE scores are comparable to those of operative treatment. While surgery tends to result in better radiographic outcomes and early improvements in grip strength (Figs. 3-8), the final functional outcomes are similar to those achieved with conservative management. Recent research indicates not only improved radiographic results, but also functional enhancements in older adults.

Despite the unclear evidence of which patients benefit most from surgery, surveys reveal a higher rate of operative treatment for these fractures than outcome data alone would suggest. Surgeons with Hand Surgery fellowships are more likely

to opt for operative treatment. Recent randomized controlled trials have shown that surgery leads to better functional and radiographic outcomes compared to conservative treatment in more active elderly patients. For displaced, unstable fractures, both functional and radiographic outcomes are superior with surgery, and complication rates are similar to nonoperative approaches

Conflict of interest statement

The Authors declare no conflict of interest

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Author contributions

The Authors contributed equally to the work.

Ethical consideration

The research was conducted ethically, with all study procedures being performed in accordance with the requirements of the World Medical Association's Declaration of Helsinki.

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