Comparison of treatment outcomes between nonsurgical and percutaneous pinning of distal radius fracture in elderly: systematic review and meta-analysis

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Received: 20 October 2021
Revised: 30 November 2021
Accepted: 06 February 2022
Published: 23 December 2022

The Egyptian Orthopaedic Journal 2022, 57:200–204

Background
Distal radius fractures (DRFs) are commonly encountered in orthopedic practice, especially in elderly patients. A number of clinical papers have supported the idea that anatomic restoration of the distal end of the radius is essential to gain superior results.
Purpose
To introduce a systematic review and meta-analysis about the results of DRF treatment in the elderly with nonoperative treatment in comparison with percutaneous pinning.
Patients and methods
This meta-analysis and systematic review were conducted in accordance with PRISMA guidelines. Medline, Cochrane, EMBASE, and Google Scholar databases were searched until November 2020, using combinations of the following search terms: DRF, wrist fractures, Colles fractures and Smith fractures, conservative treatment, nonoperative treatment, nonsurgical treatment, surgical treatment, operative, pinning, elderly, and older. Reference lists of relevant studies were manually searched.
Results
In total, five studies were included from 2005 to 2011 with total cases 265. There was statistically significant heterogeneity in the studies (I2=86.21%, P<0.0001). Using the random-effect model, the outcome results revealed that extension was significantly different in percutaneous pinning and casting group versus nonsurgical group (mean, 95% confidence interval: 69.89–93.69) with absence of publication bias.
Conclusion
The outcome results revealed that there was no significant difference between the nonsurgical and percutaneous pinning treatments of DRF in the elderly regarding grip strength, pronation, supination range of motion, and ulnar variance (pre). We also found that there was no clinically significant difference in the functional (Patient-Rated Wrist Evaluation and Disabilities of Arm, Shoulder and Hand) scores. Thus, the two methods have similar results.

Keywords:
distal radius fractures, elderly patient, meta-analysis, nonsurgical

Egypt Orthop J 2022, 57:200–204

1110-1148

Introduction

Distal radius fractures (DRFs) may be the most common type of wrist fractures, and a bimodal distribution is seen with a peak incidence in persons 18–25 years of age and the second peak in persons older than 65 years [1].

The standard DRF occurs in older patients, who have much weaker bones, and can sustain a DRF from simply falling on an outstretched hand in a ground-level fall. An increasing awareness of osteoporosis has led to these injuries being termed fragility fractures [2].

Younger patients have stronger bone, and thus, more energy is required to create a fracture in these individuals. Motorcycle accidents, falls from a height, and similar situations are the causes of high-energy DRFs, and such fractures must be considered to be a separate entity from the fractures in the older population [3].

The classification systems used most frequently for DRFs are the Frykman, Melone, AO, and Fernandez systems [4].

Patients typically present after a fall onto an outstretched hand with wrist pain, tenderness over the fracture site, swelling, and limited motion of the forearm and wrist. Deformity may be present and indicates displacement, angulation, or dislocation [5].

Examination should be performed not only of the wrist but also of the entire upper extremity to detect any associated injuries, and the affected and contralateral extremities should be compared. The skin and soft tissues should be inspected and palpated to assess for the possibility of an open fracture, compartment syndrome, or vascular compromise. Careful neurologic examination should be performed to identify median, ulnar, or posterior interosseous neuropathies, which if present, usually resolve within 2–3 weeks [6].

Radiography is the most appropriate and most commonly used modality for the initial evaluation of suspected DRFs. As such, the radiographic evaluation of radius fractures serves as this section's primary focus. Brief attention is also paid to computed tomography, as there are well-defined roles for this readily available modality in the emergency-department setting [7].

While there is a trend toward conservative management of DRFs in the elderly and plaster casting is common, recent Cochrane systematic reviews concluded that there was insufficient evidence to determine when to perform surgery, what type of surgery is best, and what nonsurgical treatment is best for the treatment of DRFs. Despite heterogeneity among studies, external fixation and Kirschner-wire (K-wire) stabilization appear to be associated with higher rates of infection [8].

Arranging elderly patients into low-demand and high-demand groups may aid in decision for the surgical management of DRFs. In patients with low demands, outcomes are adequate inspite of a present deformity. On the other hand, patients with higher demands, fracture stabilization with locking volar plates will give a better outcome [9].

Volar plating with fixed-angle screws may be more suitable for slow-healing elderly patients who are more susceptible to pin-track infection and earlier tendon irritation, leading to rupture [10].

Patients and methods

Data sources and search strategy

This meta-analysis and systematic review were conducted in accordance with PRISMA guidelines [11]. Medline, Cochrane, EMBASE, and Google Scholar databases were searched until November 2020. Reference lists of relevant studies were manually searched.

Fractures should fit at least one of the following criteria:

(1) Literature style:
   (a) Original article.
   (b) Human patients.
   (c) English language publication.
   (d) Treatment option (at least one of the following):
      (1) Closed reduction and cast immobilization.
      (2) Percutaneous K-wire fixation and immobilization.
(3) Age and follow-up period:
   (a) Age not less than 60 years.
   (b) Follow-up period more than 1 year.
(4) Report of functional results (at least one of the following):
   (a) Grip strength and arc of motion of the wrist.
   (b) Physician-rated outcome score.
   (c) Patient-rated outcome score.

Study procedure

The study started by searching articles using the keywords DRF, wrist fractures, Colles fractures and Smith fractures, conservative treatment, nonoperative treatment, nonsurgical treatment, surgical treatment, operative, pinning, elderly, and older, and then downloading papers that fulfill the inclusion criteria and excluding papers with exclusion criteria. These papers will be examined by the supervisors to make sure of finding the appropriate source of data and then I started working with the statistical supervisor and put data on R-based software for meta-analysis and started conducting the study.

Results

Study selection

Searching the databases (pubmed, Chochrane databases, Embase, Web of Science collection, and clinicaltrials.gov) led to retrieval of 64 studies. Excluded (n=44) – language other than English. Duplicates, excluded (n=10) – case reports and reviews. Studies that did not describe functional outcome included n=10.

Study characteristics

The characteristics of the included studies are summarized in Table 1. The studies included were published between 2005 and 2018. The trial design in each study was parallel-group design: eight were randomized-controlled trails and two were retrospective studies.

Table 1 Study characteristics

References	Type of the study
Konde *et al.* [16]	RCT
Chan *et al.* [17]	RCT
Lutz *et al.* [8]	RCT
Alm-Paulsen *et al.* [18]	RCT
Arora *et al.* [19]	RCT
Wong *et al.* [20]	RCT
Aktekin *et al.* [21]	Retrospective
Synn *et al.* [22]	RCT
Glickel *et al.* [23]	Retrospective
Azzopardi *et al.* [24]	RCT

RCT, randomized-controlled trail.

Patient's characteristics

A total of 949 patients were included: 645 in the nonsurgical group, and 304 in percutaneous pinning and casting group with mean age 64.3 years.

Injury characteristic: the involved side was mentioned in six studies and was mainly 89 patients on the right side and 71 on the left side, as regards Frykman's classification I : II was 35 : 25 with mean follow-up 16.8 months.

Discussion

The fracture of the distal radius is the most common injury in adults, accounting for ~17.5% of fractures [12]. Recent studies indicate that the worldwide incidence of DRFs is increasing each year owing to the overall potential to live longer with comorbidities such as osteoporosis. Although the elderly population is at greatest risk, DRFs still have a significant effect on the health and well-being of nonelderly adults. Reports have shown a significant increase of DRFs in patients aged 17–64 years [13].

At present, no meta-analysis, to our knowledge, has evaluated functional outcome in patients younger than 60 years by including all patients 18 years or older. Moreover, the high incidence of DRFs and the inconsistencies in treatment practices indicate that further investigation is warranted to understand current treatment methods and outcomes [14].

The main results of this study were as the following.

Regarding injury characteristics, the involved side was mentioned in six studies and was mainly 89 patients on the right side and 71 on the left side, as regards Frykman's classification I : II was 35 : 25 with mean follow-up 16.8 months.

Regarding the grip strength, seven studies were included from 2005 to 2014, with total cases 677. There was statistically insignificant heterogeneity in the studies (I2=14.2%, *P*=0.321). Using the random-effect model, the outcome results revealed that grip strength (kg) was insignificantly different in the nonsurgical group versus percutaneous pinning and casting group [mean, 95% confidence interval (CI): 0.00–75.34] with absence of publication bias.

While the systematic review and meta-analysis by Ochen *et al.* [12], reported that both operative and nonoperative methods revealed a significant improvement of the grip strength in favor of operative treatment in grip strength measured in kilograms [MD, 2.73 (95% CI, 0.15–5.32); *P*=0.04; I2=79%] and grip strength as a percentage of the unaffected side [MD, 8.21 (95% CI, 2.26–14.15); *P*=0.007; I2=76%].

Also, the systematic review and meta-analysis by Li *et al.* [15], reported that the volar-locking plate (VLP) fixation group had significantly better grip strength than that in the nonoperation group [weighted mean differences (WMD)=10.52; 95% CI, 6.19–14.86; *P*<0.0001] and there was better grip strength and radiographic assessment in the VLP group than those in the nonoperation group.

In the present work, six studies were included from 2005 to 2018 with total cases 325. We found that there was statistically insignificant heterogeneity in the studies (I2=11.49%, *P*=0.3419). Using the random-effect model, the outcome results revealed that pronation range of motion was insignificantly different in the nonsurgical group versus percutaneous pinning and casting group (mean, 95% CI: 0.00–78.19) with absence of publication bias.

Regarding supination range of motion, our results also showed that there was statistically insignificant heterogeneity in the studies (I2=22.91%, *P*=0.2618). Using the random-effect model, the outcome results revealed that supination was insignificantly different in the nonsurgical group versus percutaneous pinning and casting group (mean, 95% CI: 0.00–66.97) with absence of publication bias.

Also, the current results revealed that there was statistically significant heterogeneity in the studies (I2=72.75%, *P*=0.0025). Using the random-effect model, the outcome results revealed that flexion range of motion was significantly different 'higher' in favor of percutaneous pinning and casting group versus the nonsurgical group (mean, 95% CI: 37.31–88.16).

The present study involved five studies from 2005 to 2011 with total cases 265. We found that there was

statistically significant heterogeneity in the studies (I2=86.21%, *P*<0.0001). Using the random-effect model, the outcome results revealed that extension range of motion was significantly different 'higher' in favor of percutaneous pinning and casting group versus the nonsurgical group (mean, 95% CI: 69.89–93.69).

Also, our results showed that there was statistically significant heterogeneity in the studies (I2=78.63%, *P*=0.0009). Using the random-effect model, the outcome results revealed that ulnar deviation was significantly different 'higher' in favor of percutaneous pinning and casting group versus the nonsurgical group (mean, 95% CI: 48.95–91.06).

Regarding the radial deviation outcome, there was statistically significant heterogeneity in the studies (I2=93.24%, *P*<0.0001). Using the random-effect model, the outcome results revealed that radial deviation was significantly different 'higher' in favor of percutaneous pinning and casting group versus the nonsurgical group (mean, 95% CI: 88.96–95.85) with absence of publication bias.In line with our results, the systematic review and meta-analysis by Li *et al.* [15], reported that the aggregate results showed I2 values for heterogeneity in ulnar deviation of more than 50%; thus, the random-effect model was used. A significant difference between groups was observed only for ulnar deviation (WMD=2.22; 95% CI, 0.19–4.26; *P*=0.03), in which the ulnar deviation in the VLP group was higher than that in the nonoperation group. There were no significant differences in the extension and radial deviation.

As well, the systematic review and meta-analysis by Ochen *et al.* [12], reported that there was no difference regarding wrist-extension range of motion, radial deviation, and ulnar deviation.

Regarding the preulnar variance (mm), the present results showed that there was statistically insignificant heterogeneity in the studies (I2=48.37%, *P*=0.1442). Using the random-effect model, the outcome results revealed that ulnar variance (mm) pre was insignificantly different in percutaneous pinning and casting group versus the nonsurgical group (mean, 95% CI: 0.00–84.94) with absence of publication bias. While the postulnar variance (mm), the current results revealed that there was statistically significant heterogeneity in the studies (I2=91.27%, *P*<0.0001). Using the random-effect model, the outcome results revealed that ulnar variance (mm) post was significantly different in both groups 'higher' in favor of the nonsurgical group (mean, 95% CI: 84.58–95.05) with absence of publication bias.

Regarding radial length pre, the current results showed that there was statistically significant heterogeneity in the studies (I2=77.69%, *P*=0.0343). Using the random-effect model, the outcome results revealed that radial length pre was significantly different in both groups (mean, 95% CI: 2.52–94.89) with absence of publication bias. There was statistically significant heterogeneity in the studies (I2=95.66%, *P*<0.0001). Using the random-effect model, the outcome results revealed that radial length post was significantly different 'higher' in favor of percutaneous pinning and casting group versus nonsurgical group (mean, 95% CI: 87.45–98.50) with absence of publication bias.

Regarding the functional outcomes, Patient-Rated Wrist Evaluation (PRWE) score-3 studies were included from 2005 to 2011 with total cases 135 and the results showed that there was statistically insignificant heterogeneity in the studies (I2=0.00%, *P*=0.9673). Using the random-effect model, the outcome results revealed that PRWE score was insignificantly different in percutaneous pinning and casting group versus nonsurgical group (mean, 95% CI: 0–0) with absence of publication bias.

Finally, regarding the Disabilities of Arm, Shoulder and Hand (DASH) score 6, studies were included from 2005 to 2014 with total cases 595. We found that there was statistically insignificant heterogeneity in the studies (I2=0.00%, *P*=0.608). Using the random-effect model, the outcome results revealed that DASH score was insignificantly different in percutaneous pinning and casting group versus nonsurgical group (mean, 95% CI: 0–65.79) with absence of publication bias.

Conclusion

The present systematic review and meta-analysis concluded that the outcome results revealed that there was no significant difference between the nonsurgical and percutaneous pinning treatments of DRF in the elderly regarding grip strength, pronation, supination range of motion, and ulnar variance (pre). Whereas flexion, extension range of motion, ulnar deviation, radial deviation, ulnar variance (post), and radial length (pre and post) was significantly different in percutaneous pinning and casting group versus nonsurgical group. We also found that there was no clinically significant difference between surgical treatment and nonsurgical treatment as measured by the functional (PRWE and DASH) scores. Thus, the two methods have similar results.

Recommendations

Further large-scale clinical studies are needed to verify the results, and to provide new ideas for the pathogenesis of sepsis and early treatment.

Further research is needed for the development of patient-specific and fracture-specific guidelines.

Future systematic reviews should be carried out based on well-designed, prospective studies and set up subgroups separately according to different indications when enough reports are available.

Outcome measurement specifically for elderly patients should include performance of activities of daily living and exclude heavy vocational labor.

Study limitations

There are some limitations of this study. The number of studies along with the inclusion criteria was small, less than five studies suitable for meta-analysis in some of the outcome categories, and in some categories, only two data sets were available for inclusion in the analysis. There was a difference in the surgical procedures performed, and the inclusion of K-wire fixation, external fixation, and Open Reduction Internal Fixation (ORIF) by locking plates made the operative group heterogeneous. No examination of the effects of complications caused by these two broadly defined types of intervention was done. Follow-up time of the studies also varied, as did patient-selection criteria.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

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