Osteoporosis International (2023) 34:659–669
https://doi.org/10.1007/s00198-022-06649-8

REVIEW

Efficacy of cast immobilization versus surgical treatment for distal radius fractures in adults: a systematic review and meta-analysis

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Received: 21 July 2022 / Accepted: 13 December 2022 / Published online: 20 December 2022

Abstract

Summary This article includes high-quality randomized controlled trials in recent years and updates the past meta-analysis. It has been proved that cast immobilization can achieve similar functional results, reduce economic burden in the long-term compared with surgery, and provide a basis for doctors to make treatment choices.

Purpose The efficacy of conservative and surgical treatment of distal radius fractures (DRFs) in adults is still controversial. Recently, some high-quality randomized controlled trials (RCTs) evaluated the efficacy of both treatments. We hypothesized that treatment of DRFs with closed reduction and cast immobilization would achieve functional outcomes similar to surgery.

Methods This study is a systematic review and summary of RCTs comparing conservative and surgical management of DRFs from 2005 to March 2022. Patients were evaluated for functional and imaging outcomes and complications.

Results A total of 11 studies [1–11] included 1775 cases of DRFs. At 1-year follow-up, the cast group had lower mean differences (MDs) in DASH scores than the surgery group by − 2.55 (95% CI = − 5.02 to − 0.09, $P = 0.04$); with an MD of 1.63 (95% CI = 1.08–2.45, $P = 0.02$), while the surgery group had a lesser complication rate than the cast group.

Conclusions At 1-year follow-up, the lower DASH scores of the cast group showed advantages of this treatment, but the complication rate was higher than that of the surgery group. There was no massive distinction in other scoring methods.

Keywords Cast immobilization · Distal radius fractures · Randomized control trial · Surgical treatment

Abbreviations

DRFs Distal radius fractures
RCTs Randomized controlled trials

Introduction

Among orthopedic diseases, distal radial fracture (DRF) is one of the most common fractures. According to the literature, the occurrence of DRFs may be multifactorial, and the age groups under 18 and over 65 have the highest proportion of DRFs (30.18 and 25.42/10,000, respectively) [1]. Foreign literature reports predict that by 2028, the number of DRFs in Australian adults over the age of 35 will grow at a rate of 20% per year, and by 2051, 60% increase of cases annually is expected [1, 2]. This phenomenon is due to the aging population. In recent years, the treatment of DRFs is mainly divided into surgical and conservative treatments. The surgical treatment of the distal radius mainly includes special materials, such as a locking plate, a Kirschner wire, and an external fixator. The conservative treatment is mainly closed reduction and cast immobilization [3]. Although the disease is very common and the treatment methods are ideal, the choice between conservative and surgical treatment has caused dilemma among clinicians.

There are some studies which support the view that surgical treatment is more effective than conservative treatment owing to the advantages, such as earlier function recovery and lower reoperation rate [4–6]. Although many studies support surgical treatment of DRFs, there are more studies that have reported the complication rate of DRF is still as high as 8–27% [7–9]. On the other hand, some studies have shown that the benefits of the cast fixation are similar to surgery. Postoperative consequences were not significantly

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different between conservative and surgical treatments; hence, cast application is more cost-effective. As a result, older adults who have more DRFs are more likely to choose conservative therapy [10]. In 2020, the American Academy of Orthopedic Surgeons and the American Society for Surgery of the Hand published new Clinical Practice Guidelines on assessing and treating acute DRFs. Strong evidence demonstrates that operational treatment for geriatric patients does not result in improved long-term patient-reported outcomes compared to nonoperative treatment [11]. A recent randomized controlled trial found that specific treatment options have insufficient evidence [12].

This is a meta-analysis based on the relevant contents published for many years. However, a previous meta-analysis was published many years ago and the study needs to be updated. Several randomized control trials (RCTs) tackling this problem have recently been published, with no fewer than three high-quality RCTs included, allowing for a powerful revision of the results.

In this meta-analysis, 11 RCTs [13–23] were included, which evaluated the efficacy of closed reduction and cast immobilization and surgery in treating adult DRFs. We assume that the cast group and surgery group can obtain similar prognostic effect, so as to provide a basis for clinicians to choose conservative treatment.

Methods

Literature search

The PRISMA guidelines [10], which is the ideal reporting item for systematic reviews and meta-analyses, was used to conduct this study. The two authors searched extensively for articles published in PubMed, the Cochrane Library, and EMBASE between 2005 and March 2022. The following retrieval strategy was used: (((((((Radius Fractures[MESH]) OR (Wrist Injuries[Title/Abstract])) OR (Wrist Injuries[MESH])) OR ((radius[Title/Abstract] OR radial[Title/Abstract] OR wrist[Title/Abstract] OR colles[Title/Abstract] OR smith*[Title/Abstract]) AND fracture*[Title/Abstract])) OR (distal near radial[Title/Abstract])) OR (distal near radial[MESH])) OR (fractur*[Title/Abstract])) AND ((((((orthopedic procedure[MESH]) OR (orthopedic procedure[Title/Abstract])) OR (orthopedics[MESH])) OR (orthopedics[Title/Abstract])) AND ((conservative treatment[MESH])) OR (Physical therapy modalities[MESH])) OR (conserv*[Title/Abstract] OR conven*[Title/Abstract] OR non-operat*[Title/Abstract] OR nonsurg*[Title/Abstract] OR cast*[Title/Abstract] OR splint*[Title/Abstract] OR brace*[Title/Abstract] OR Plaster*[Title/Abstract] OR bandage*[Title/Abstract] OR Tap*[Title/Abstract]))) AND ((((surgical procedure, operative[MESH]) OR (surgical procedure, operative[Title/Abstract])) OR (fracture fixation[MESH])) OR (fracture fixation[Title/Abstract]))). Each title, abstract, and main text of the searched studies were examined if it fulfilled the criteria. Also, reference lists were checked for any other literature that could have met the criteria.

Eligibility criteria

In this study, potential inclusion criteria were as follows: (1) RCTs evaluating the outcomes of conservative versus surgical management in DRFs, (2) participants were cases with a definitive diagnosis of DRFs, (3) studies reporting functional outcomes, (4) data from which participant characteristic outcomes can be extracted, and (5) English-language literature. Exclusion criteria were as follows: (1) protocols, abstracts, letters, or meeting minutes, (2) study subjects were < 18 years old. The inclusion and exclusion criteria of 11 RCT studies are shown in Table S4. Complications were defined as malunion of bone, infection (needle tract infection, superficial wound infection, deep wound infection, Tendon irritation, inflammation and rupture, carpal tunnel syndrome, osteoarthritis), secondary operations (carpal tunnel decompression, corrective osteotomy, tendon repair), fracture displacement, complex regional pain syndrome (CRPS), deep vein thrombosis, damage to blood vessels and nerves, implant-related (failure, irritation), scar adhesion and keloid, and de Quervain syndrome.

Data obtaining

Two researchers independently reviewed all studies collected from the database (Qifan. Yang and Jing. Liu). Using standardized tables, the same researchers extracted all relevant data separately. Another senior reviewer decided on all data discrepancies that cannot be resolved through negotiation (Xinyu. Wang). Basic article features (such as title, first author, year of publication, and study design) were retrieved from each included study, as well as sample characteristics (age, gender, and study population), surgical method, scoring criteria, and follow-up time.

Bias risk assessment

Each study was assessed using the Cochrane Collaboration's risk of bias tool [10]. The risk of bias for each study was divided into three categories from low to high, according to the guideline. The detailed evaluation process included the following items: (1) sequence generation, (2) allocation concealment, (3) participant blinding, (4) outcome evaluation blinding, (5) evaluation of incomplete outcomes, (6) completeness of data presentation, and (7) other biases. Items were identified as unclear when the information provided was insufficient to warrant their award to objects with a low or high risk of bias.

Study quality assessment

Two reviewers (Qifan. Yang and Guoyong. Cai) separately assessed the strength of information using the Jadad scale [11]. Each included study was given a score from 0 to 5 based on how well it performed on the three components of the Jadad scale (Table S1). Participants were chosen at random, grouping was blinded, and each participant was held accountable. One or two stars were given for "yes" response for "randomization" and "blinding," and one star was granted for the "yes" answer for "accountability." Studies with one or two stars were assessed as having low quality to establish a minimum criterion for inclusion in the current study.

Statistical analysis

Discrete variables, such as complications of each group, were estimated and pooled by risk ratio (RR) and appropriate 95% confidence interval (CI). Mean difference (MD) and 95% CI were employed to pool continuous variables, such as wrist range of motion (ROM). The pooled variables were subjected to an inverse variance procedure with a random model. The I^2 statistic was used to assess the heterogeneity in each analysis. Heterogeneity in each analysis process was identified as lower (I^2 less than 25%), moderate (I^2 between 25 and 50%), and higher (I^2 more than 50%) [11]. For the process with $50\% \le I^2$, Begg's rank correlation [12] and Egger's weighted regression method were employed to evaluate the publication biases in the analysis processes. The participants' characteristics and the outcomes of each group were used to stratify the analysis. Review-Manager was used to complete pooled processes and forest plots (version 5.4, The Cochrane Collaboration, Oxford, UK). A P-value of less than 0.05 was considered to be statistically significant in all analyses.

Results

Study inclusion

After an initial search, 1436 articles were found in the literature manager, with 216 being eliminated owing to duplication. Most of the remaining articles were removed without conforming to the PICO principles. Finally, 11 studies were chosen from 46 full-text manuscripts for the current investigation. Figure 1 depicts the literature screening procedure.

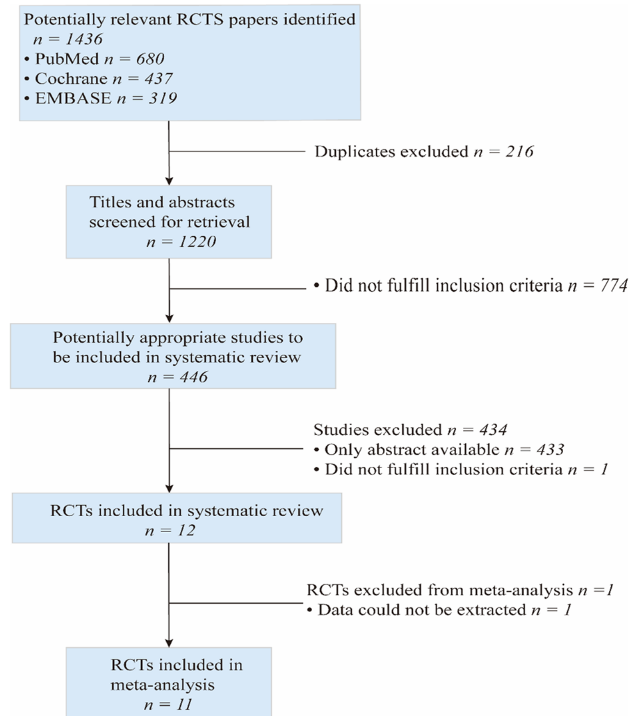

Fig. 1 Flowchart of the study selection process

Study characteristic

A total of 1775 DRFs were included in the current study. The 11 studies were from the UK ($n=2$), Pakistan ($n=1$), Netherlands ($n=2$), Australia ($n=1$), Norway ($n=1$), USA ($n=1$), Finland ($n=1$), Sweden ($n=1$), and Spain ($n=1$). The characteristics of the participants are shown in Table 1.

Risk of bias and quality assessment

The studies examined were deemed to have a low risk of bias and high quality (Fig. 2). The Jadad scale was used as the scoring standard for the 11 RCTS included. The scores were as follows: 4 articles were 4 points, 2 articles were 6 points, and the remaining articles were 7 points. Points were deducted due to a lack of information regarding blinding in some research protocols (Supplementary Table 1).

Meta-analysis of outcome

- ***DASH scores (disabilities of the arm shoulder and hand score)***

  Five RCTs [15, 16, 18, 20, 24] reported DASH score data for 472 patients (Fig. 3). The higher the score, the more disabled and less functional. A score of 0 means normal upper limb function, and a 100 means minimal upper limb function. All patients in the cast group

Table 1 Characteristics of the included studies

Study	Country	Cast group			Operation group			Types of fracture	Intervention	Outcome	Measurement timepoint (month)
		Sample size	Age (year)	Female (%)	Sample size	Age (year)	Female (%)				
M Costa, 2022	UK	255	59.6(17)	0.83	245	60.7(16)	0.84	AO-A AO-B AO-C	K-wire fixation	1. PRWE 2. QOL 3. Complications	3 m 6 m 1 year
Muhammad T, 2021	Pakistan	72	81(2)	—	87	81(2)	—	AO-A	Volar plate fixation	1. PRWE 2. DASH 3. The Mayo wrist score 4. Any adverse event 5. Complication 6. SF-12	3 m 1 year
Selles C A 2021	Netherlands	46	59 (33.9)	0.87	44	62 (41.1)	0.82	AO-C1	Volar plate fixation	1. PRWE 2. DASH 3. SF-36	3 m 6 m 1 year
Lawson A, 2021	Australia	85	71.3 (7.6)	—	81	70.5(7)	—	AO-A AO-C	Volar plate fixation	1. PRWE 2. DASH 3. QOL 4. Complications	3 m 1 year
Hassellund S, 2021	Norway	50	73.9 (58.7)	0.42	50	73.4 (66.3)	0.47	AO-A AO-C	Volar plate fixation	1. PRWE 2. DASH 3. EQ-5D-5L 4. ROM 5. Grip strength 6. Satisfaction with wrist function 7. Complications	3 m 6 m 1 year
ChungK. C, 2020	US	109	76	0.85	187	68	0.89	AO-A AO-C	Volar locking plate EF Percutaneous pinning	1. MHQ 2. SF-36	2w 6w 1 year
Marjolein A.M, 2019	The Netherland	43	60 (9.63)	0.84	47	59 (17.78)	0.66	AO-C	Volar plate fixation	1. DASH score 2. PRWE 3. SF-36 4. Range of motion 5. Grip strength 6. radiographic Parameters 7. Complications	1w 3w 6w 3 m 6 m 1 year

Table 1 (continued)

Study	Country	Cast group			Operation group			Types of fracture	Intervention	Outcome	Measurement timepoint (month)
		Sample size	Age (year)	Female (%)	Sample size	Age (year)	Female (%)				
Sirniö K, 2019	Finland	42	64 (23.7)	0.929	38	62 (21.5)	0.974	AO-A1, A2 AO-C1, C2	Volar plate fixation	1. DASH 2. Movement and grip strength 3. Radial inclination	3 m 6 m 1 year 2 years
Jenny S, 2019	Sweden	72	78	0.88	68	80	0.95	—	Volar plate fixation	1. PREW 2. ROM and grip strength 3. Radiographs 4. Complications	4–5w 3 m 1 year
Azzopardi T, 2005	UK	27	71(9)	0.93	27	72(8)	0.93	AO-A3	Percutaneous pinning	1. ROM and grip strength 2. ADL 3. Pain score 4. SF-36 5. Radiological measurements 6. Complications	1w 2w 5w 4 m 1 year
Daniel M.M, 2017	Spain	47	70(7)	0.79	50	67(8)	0.78	AO-C	Volar plate fixation	1. PRWE-total 2. DASH 3. VAS-pain 4. ROM 5. Grip strength 6. Radiological parameters	2 w 6 w 6 m 1 year 2 years

Abbreviations: *EQ-5D-5L* EuroQol five-dimension five-level scale, *EQ-VAS* EuroQol visual analogue scale, *VAS* visual analogue scale, *PCS* physical component summary, *MCS* mental component summary, *DASH* Disabilities of the arm, shoulder and hand), *Rom* range of motion, *SF-36* 36-item short-form, *SF-12* 12-item short-form, *ADL* Activity of daily living scale, *PRWE* patient-rated wrist evaluation, *QOL* quality of life, *MHQ* Michigan hand outcome questionnaire

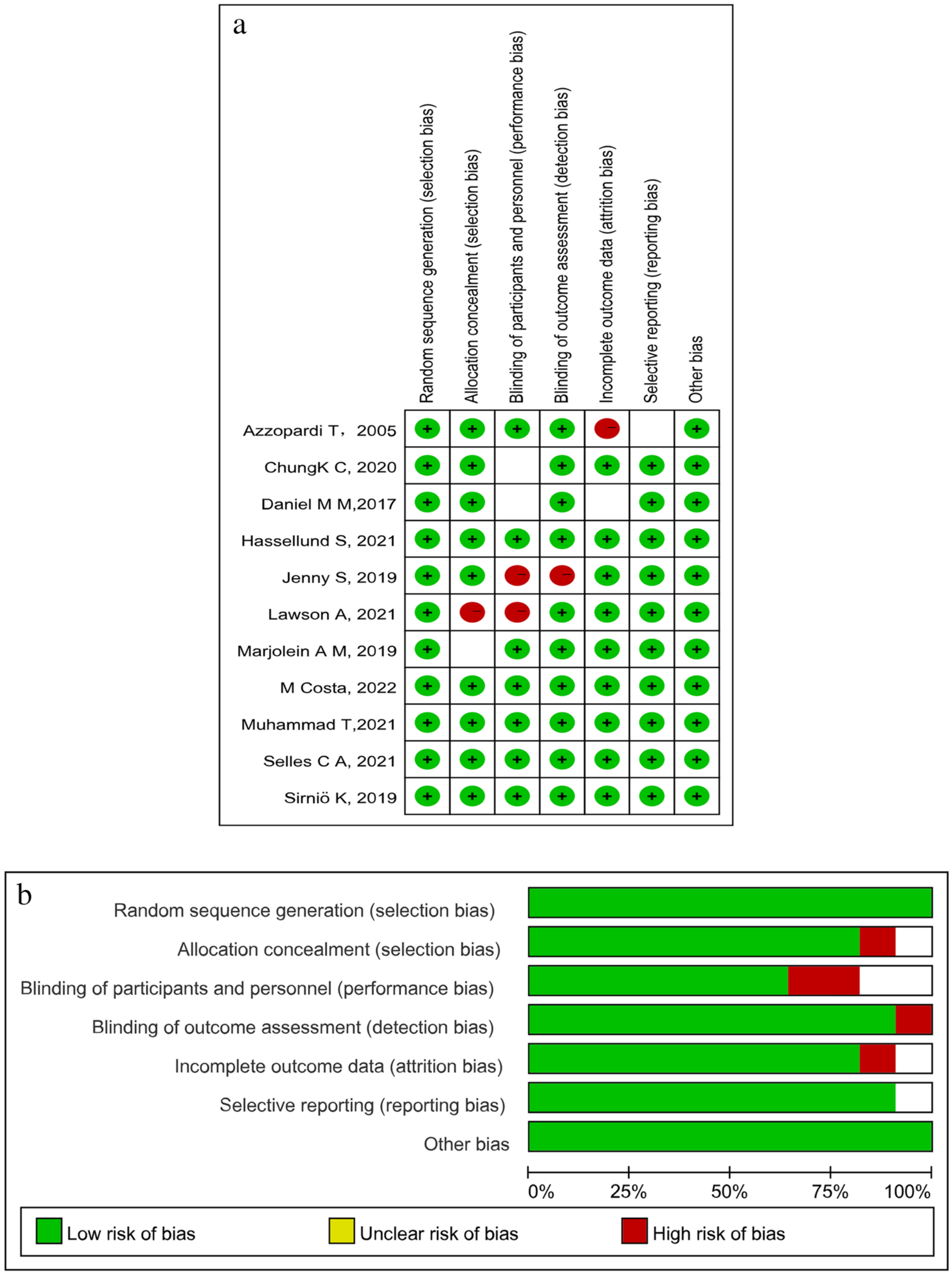

Fig. 2 The Cochrane Library for RCTs' Risk of Bias test was used to assess the quality of the RCTs that were included. **a**Author judgments on each risk of bias item for each included study, and **b** percentages for each risk of bias item across all included studies

had lower DASH scores than the surgery group after 1 year, with MDs of − 2.55 (95% CI = − 5.02 to − 0.09, $P = 0.04$). This result was assessed with low heterogeneity ($I^2 = 42\%$, $P = 0.14$) (Fig. 3, Table S3).

The results of sensitivity analysis showed that two experiments [16, 20] had a specific impact on the robustness of the score, which may be related to the sample size and measurement bias. The Egger test result was $P = 0.394$, with no obvious publication bias. Steady (Table S6).

- ***Grip strength***

The findings on grip strength were published in four RCTs [15, 16, 19, 24] with a total of 456 individuals (Table S2). There was no significant difference between the cast group and the surgery group, with MDs of 0.24, 95% CI and P values are − 1.8 to 2.28, and the P-value was 0.82. Low heterogeneity was determined ($I^2 = 0\%$, $P = 0.75$) (Table S3).

Sensitivity analysis showed that the overall result of the score was relatively robust. The result of Egger's test was $P = 0.869$, with no obvious publication bias (Table S6).

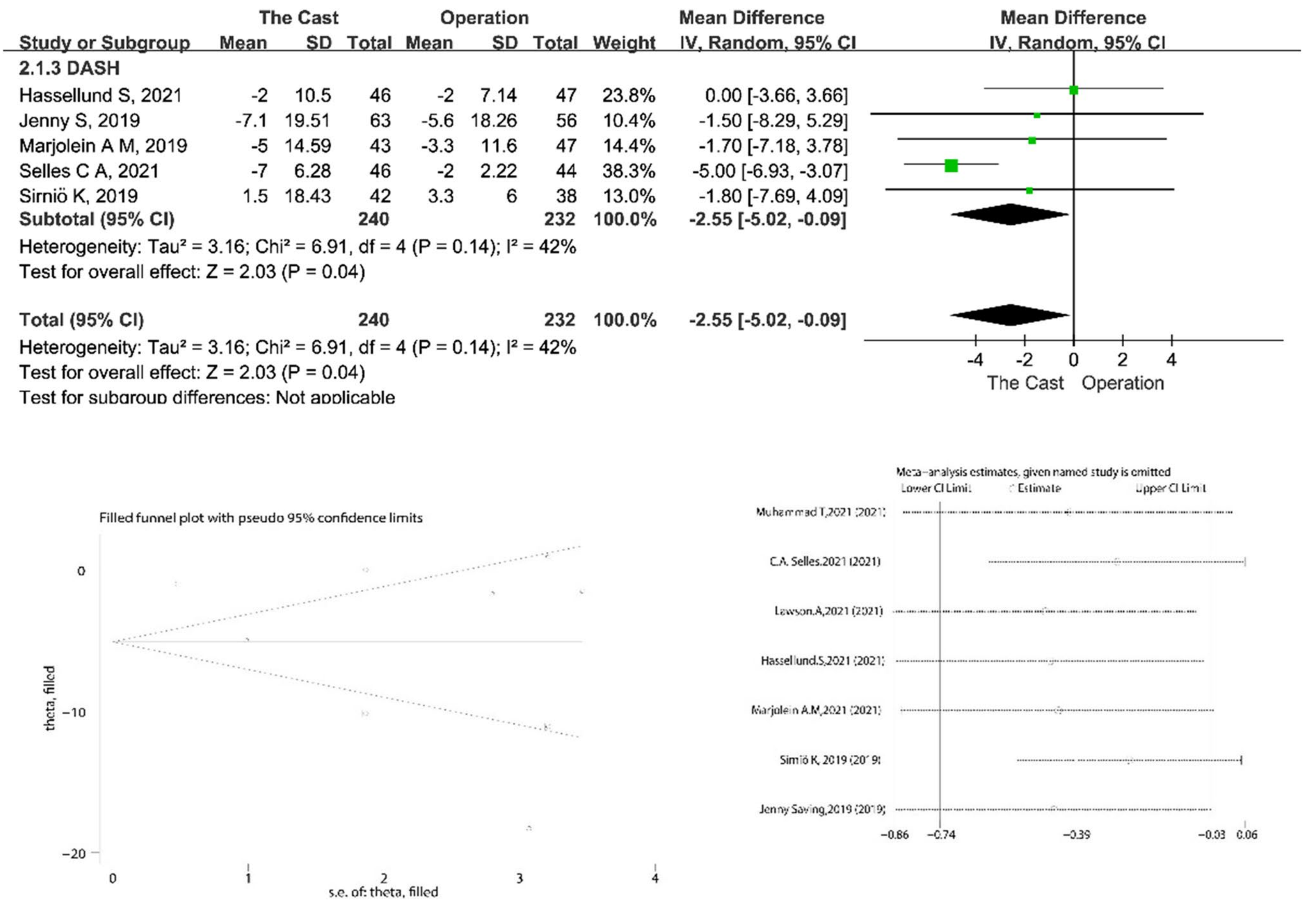

Fig. 3 DASH (forest plots, funnel plots, and sensitivity analysis)

- ***EQ-5D-5L(EuroQol five-dimension five-level scale)***
  The score included three RCTs [15, 19, 22] reporting data on 679 patients (Table S2). There was no significant difference in EQ-5D-5L between the cast group and the surgery group at 1 year after surgery, with an MD of − 0.03 (95% CI = − 0.06 to 0.00, $P = 0.05$). This result was assessed with low heterogeneity ($I^2 = 0\%$, $P = 0.83$) (Table S3).
  Overall, the results of sensitivity analysis showed the scores were relatively robust, and the effects of Egger's test was $P = 0.904$, with no significant publication bias (Table S6).
- ***EQ-VAS (EuroQol visual analogue scale)***
  A total of two RCTs [19, 22] reported the following data in Table S2. The results found that the differences between the cast and surgery group were not statistically significant, and heterogeneity was modest ($I^2 = 0\%$, $P = 0.41$), MD = 1.73, $P = 0.27$, 95% CI = − 1.37 to 4.83 (Table S3).
  The sensitivity analysis results show that the overall effect of this score was not robust. Based on previous literature, it is suspected that the result is caused by related factors, such as the small sample size of Combined Randomised and Observational Study of Surgery for Fractures in the Distal Radius in the Elderly (CROSSFIRE) Study Group [19]. The result of Egger's test was $P = 0$, with a relatively obvious publication bias (Table S6).
- ***PRWE (patient-rated wrist evaluation)***
  As shown in Table S2, PRWE scores were provided in six RCTs [15, 18–20, 22, 24], which included 949 patients. Subgroup analyses were performed at 3 months, 6 months, and 1 year after surgery. The pooled results showed that there was no significant difference between the two groups. The data revealed MDs at 1.23, 95% CI: − 1.67 to − 4.14, $P = 0.41$, and the heterogeneity was high. At 3 months, there was no significant difference. The MDs and 95% CI were − 2.30 (95% CI = − 5.89 to 1.28, $P = 0.21$), and the heterogeneity was considered to be low at $I^2 = 0\%$, $P = 0.68$, respectively. At 6 months, there was no significant difference. The MDs and 95% CI were − 2.09(95% CI = − 5.53 to 1.35, $P = 0.23$); the heterogeneity was $I^2 = 0\%$, $P = 0.42$. At 1 year after surgery, the surgery group was 4.88 points higher than the

cast group, with a 95% CI of 1.89–7.87, $P=0.01$, with high heterogeneity ($I^2=51\%$, $P=0.07$) (Table S3).

Subgroup analysis found that the results showed greater heterogeneity within 1 year, and through sensitivity analysis, we suspected that it was because of the different inclusion criteria of Selles et al. [20], which included more intra-articular fractures (type C1.1), so surgical treatment can achieve better results than conservative treatment. The reported data introduces bias, possibly consistent with the results exhibited by the individual subgroups and the overall results. The result of Egger's test was $P=0.241$, with no significant publication bias (Table S6).

- ***ROM (flexion, extension, pronation, supination, radial deviation, and ulna deviation) (Table* S3)**

  o ***Flexion***

  Outcomes at flexion were assessed at 12 months and included a total of four RCTs [15–17, 24], including 452 patients. There was no significant difference between the cast group and the surgery group (MD = − 1.09, 95% CI = −3.63 to 1.46, $P=0.4$), which was considered to have low heterogeneity ($I^2=0\%$, $P=0.42$).

  p ***Extension***

  The data covered four RCTs [15–17, 24] with 463 patients. There was no significant difference between the cast group and the surgery group (MD = − 1.06, 95% CI = −4.51 to 2.39, $P=0.55$), which was considered to have low heterogeneity ($I^2=46\%$, $P=0.13$).

  q ***Pronation***

  The pronation results covered three RCTs [15, 16, 24] with 289 patients. There was no significant difference between the cast group and the surgery group (MD = − 1.07, 95% CI = −2.94 to 0.80, $P=0.26$), which was considered to be highly heterogeneous ($I^2=0\%$, $P=0.75$).

  r ***Supination***

  A total of three RCTs [15, 16, 24] reported data on supination. The data showed that the difference between the cast group and the surgery group was not statistically significant (MD = −3.06, 95% CI = −7.77 to 1.65, $P=0.20$), which was considered with high heterogeneity ($I^2=65\%$, $P=0.06$).

  s ***Radial deviation***

  A total of four RCTs [15–17, 24] reported data on radial deviation. The data showed that the difference between the cast group and the surgery group was not statistically significant (MD = 0.56, 95% CI = − 1.74 to 2.87, $P=0.63$), which was considered with high heterogeneity ($I^2=59\%$, $P=0.06$).

  t ***Ulna deviation***

  A total of three RCTs [15, 16, 24] reported data on ulnar deviation. The data showed no statistically significant difference between the cast group and the surgery group (MD = − 1.52, 95% CI = −3.75 to 0.70, $P=0.18$), which was considered with low heterogeneity ($I^2=0\%$, $P=0.39$).

  The data showed no statistically significant difference between the cast group and the surgery group (MD = −0.94, 95% CI = −2.02 to 0.14, $P=0.09$) in ROM; sensitivity analysis showed that the overall results of the ROM score were relatively robust. The result of Egger's test was $P=0.592$, with no significant publication bias (Table S6).

- ***PCS (physical component summary) and MCS (mental component summary)***

  PCS and MCS data were reported in three RCTs [17, 20, 24] with a total of 347 patients (Table S2). The data showed that there was no significant difference in PCS and MCS between the cast group and the operation group, the MDs were 1.01–4.47, with 95% CI −0.18 to 2.19 and P values were $P=0.1$, −2.44 to 11.39, $P=0.2$. PCS had heterogeneity ($I^2=0\%$, $P=0.92$) and MCS had heterogeneity ($I^2=89\%$, $P=0.75$) (Table S3).

Sensitivity analysis results showed that the PCS and MCS results were less robust, which may be due to the study by Selles, CA [20], and the MCS results were less robust, suspected to be due to Mulders, MAM [24]. Based on literature, it was suspected that the patient's initial level was related to the subjective reporting results. The Egger test results for PCS and MCS were $P=0.569$ and $P=0.373$, respectively, with no significant publication bias (Table S6).

Complications

Complication rates were reported for all 1775 patients included in the 11 RCTs [13–22, 24], and the results are shown in Table S2. Compared with the surgery group, the cast group had a higher incidence of complications, with an RR of 1.63 (95% CI: 1.08–2.45, $P=0.02$). The results were rated with high heterogeneity ($I^2=79\%$, $P<0.00001$) (Table S3). The expressly stated complications in the included studies are shown in Table S5. The form can see that the proportion of fracture displacement in the plaster group is relatively large. In the operation group, infection, irritation, and failure of internal fixation need to be paid close attention to.

Sensitivity analysis results were less robust and were suspected to be caused by three studies. According to previous studies, the suspicion was related to different sample sizes and inclusion criteria for complications. The results of

Egger's test had a $P = 0.75$, with no significant publication bias (Table S6).

Sensitivity analysis and publication bias detection

Through data analysis, some results showed high heterogeneity. We used sensitivity analysis, subgroup analysis, and Egger's test to explore the source of heterogeneity. It was found that the results are relatively stable, and there was no noticeable difference. The publication bias of the individual results for specific analysis is shown in Table S6.

Discussion

The purpose of this article was to summarize and analyze the research progress and options of cast immobilization and surgical treatment in the management of acute DRFs.

The overall results showed that there was a significant difference in DASH score between the cast group and surgical group MDs = –2.55 (95% CI = –5.02 to –0.09, $P = 0.04$). With low heterogeneity, the results of DASH scores have higher credibility. The results of data analysis suggest that the recovery of upper limb function in the cast group is better than that in the surgical group. The summarized results of DASH scores are consistent with the hypothetical results of this article, which supports the decision of cast immobilization after the operation of distal radius fracture. It also outlines the evidence related to the incidence of complications after treatment of DRFs at 3 months, 6 months, and above. The cast fixation group had a higher incidence of complications than the surgical group, and the difference was statistically significant. In the heterogeneity analysis section, the results and significance of the specific sensitivity analysis are presented.

Furthermore, according to our findings, there was no substantial change in grip strength, EQ-5D-5L, EQ-VAS, or other indexes between the cast and surgical groups. Although both EQ-VAS studies can be used to analyze high-quality literature, it may not be enough to provide more convincing results due to the limitation of sample size, so it is difficult to conclude that this index provides adequate evidence for clinicians' decision-making. Therefore, cast therapy may bring better benefits to patients with adult and elderly DRFs than surgical treatment.

The DASH results of the current meta-analysis are consistent with the results of previous studies [16, 20], which support that cast treatment is better than surgical treatment. However, the results of this meta-analysis and Mulders et al. [24] differed from the findings of Selles et al. [20], which mainly included patients with intra-articular fracture displacement of the distal radius (complete joint type C1.1), and closed reduction is acceptable [20]. The patients included in this meta-analysis were confirmed cases of DRFs. Considering that different fracture types may be specific, it will impact the long-term DASH score. In addition, Yifan Chen (2020) believes that surgical treatment of DRFs is better than cast treatment in ROM [25]. This meta-analysis showed no significant difference after 1-year follow-up. This evidence is consistent that of other studies [18, 26].

Regarding ROM, this study does not support the evidence that surgical treatment is more valuable than cast treatment. We performed a meta-analysis of PRWE scores at 3, 6, and 12 months after operation by collecting the data of 6 RCTs [15, 19–21, 23, 24]. The results showed that many patients with wrist fractures had no significant difference between 3 and 6 months after surgery. After 1 year, the scores of surgical treatment and conservative treatment began to show statistical differences. However, the follow-up results after 1 year were highly heterogeneous, which was difficult to provide analytical results. This meta-analysis was then verified by subgroup analysis using a random-effect model to investigate the origins of heterogeneity. It was found that except for C.A. Sellers (2021) [20] the literature had high heterogeneity. It was considered that different inclusion criteria may have caused high heterogeneity. Regarding ROM, this study believes that DRFs treated with cast can achieve the same effect as surgical treatment. In some studies, the heterogeneity of supination and radial deviation in the ROM score may also be derived from the difference in the time of wrist movement after DRF. Marjolein A.M [20] mentioned that for patients who underwent DRF surgery, the management of postoperative pain allows the movement of the wrist. For patients treated with DRF surgery, Simio K [16] used a back cast to relieve pain for 10 days, after which the patient received formal guidance to move the wrist actively. The difference in the wrist joint's braking time and activity time after surgery may have a specific impact on the speed and degree of fracture healing and joint activity recovery.

The author discovered that in adult DRFs, the surgical group had a significantly lower rate of complications than the cast group. However, due to its diversity, sensitivity analysis reveals that the results are consistent, implying that the results are very stable and that there is no noticeable publishing offset, meaning that the findings of this study are highly credible. This evidence differs from the findings of some RCTs [15, 18, 19, 22, 26, 27], which prefer conservative treatment and surgical treatment, and there is no significant statistical difference in complications. The evidence of difficulties in this paper is consistent with [21]. Although surgical treatment has a lower incidence of complications, there is no significant difference between cast treatment and surgical treatment in ROM, grip strength, EQ-5D-5L, EQ-VAS, and so on. An in-depth cost analysis of the DRFs fixation trial (draft) [27] showed that low-cost fixation could provide similar results to ORIF. In addition, a newly published guide on DRFs in the USA [3] provides strong evidence that compared to nonoperative treatment, surgical treatment for geriatric patients (65 years and older) does not result in improved long-term patient-reported outcomes (strong strength). Therefore, at present, we still cannot conclude that surgical treatment can bring better prognosis to such patients.

Our meta-analysis included 11 RCTs for general analysis, of which nine were RCT studies published in the recent 3 years. According to the Jadad scale, four RCTs were scored 4 points, two RCTs scored 6 points, and the remaining RCTs scored 7 points. The included RCTs provided high-quality evidence for treating DRFs in adults. Although the main reason for score deduction of some studies was no information provided regarding blinding, the RCT studies with the lowest score on the Jadad scale are still of high quality. We then tested the publication bias of each index with the Egger test, and the results showed that there was no obvious publication bias, indicating that the results of this article are highly reliable.

Our meta-analysis mainly included patients with DRFs in adults and the elderly, but not children. Considering that the bone density and bone mass of adults and the elderly are different from those of children, the fracture healing speed and bone remodeling of children are faster than those of adults. Many studies have found a strong link between functional and anatomical outcomes in young children who are highly functional and active; hence, we excluded RCTs which involved children. The 11 RCTs included in this meta-analysis are mainly articles published in developed countries such as North America and Europe. Neither research included in the review mentioned whether or not the patients had any additional illnesses. Because it has the potential to cause or contribute to negative repercussions, as a result, this component may cause heterogeneity and possibly diminish the results' dependability.

Conclusion

The current study evaluated the outcomes of cast immobilization and surgery for DRFs. It was analyzed that the cast group exhibited better results in DASH than the surgery group at 1-year follow-up, with no significant differences in ROM, PRWE, and grip strength. In terms of complications, the surgical group showed the lower complication rate within 1 year after surgery. Cast immobilization can reduce the financial burden of a considerable number of patients. Therefore, this study may provide better evidence support for future clinicians to use cast immobilization for DRFs. In the literature included in this article, some of the patients included in the RCT studies had type C fractures. However, most were AO-C1 fractures, which can maintain good stability after reduction, so it still has guiding significance for the treatment of uncomplicated DRF patients. However, the included sample size is far from enough compared with the global incidence of DRF. Therefore, higher quality and more extensive sample size studies are needed in the future for simple DRF fractures and AO-C fractures to improve the reliability of the evidence. For details, see Table S7.

Supplementary Information The online version contains supplementary material available at https://doi.org/10.1007/s00198-022-06649-8.

Acknowledgements Dong. Zhu and Qifan. Yang conceived the design of this manuscript. Qifan. Yang and Guoyong. Cai screened out eligible studies separately. Qifan. Yang and Jing. Liu accomplished data collection, analysis of results, and editing of the final manuscript. Dong Zhu discussed the controversial parts of literature screening and quality evaluation. Dong. Zhu and Xinyu. Wang supervised the entire process and revised the manuscript. All the authors have read and approved the manuscript.

Funding The authors thank the National Natural Science Foundation of China (Grant numbers: No12072129) for the financial support.

Declarations

Ethics approval All human and animal studies have been approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki and its later amendments.

Conflict of interest None.

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