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Volar locking plate vs cast immobilization for distal radius fractures: a systematic review and meta-analysis

Lorenzo Massimo Oldrini[1], Pietro Feltri[1], Jacopo Albanese[1], Stefano Lucchina[1,2,3], Giuseppe Filardo[1,4] and Christian Candrian[1,4]

[1]Service of Orthopaedics and Traumatology, Department of Surgery, EOC, Lugano, Switzerland
[2]Surgical Department - Hand Surgery Unit EOC, Locarno's Regional Hospital, Locarno, Switzerland
[3]Locarno Hand Center, Locarno, Switzerland
[4]Faculty of Biomedical Sciences, Università della Svizzera Italiana, Lugano, Switzerland

Correspondence should be addressed to L M Oldrini
Email
lorenzomassimo.oldrini@eoc.ch

- *Introduction:* The aim of this systematic review and meta-analysis was to evaluate whether volar locking plate (VLP) fixation leads to better clinical and radiological outcomes than those of closed reduction and cast immobilization for the treatment of distal radius fractures (DRFs).
- *Materials and methods:* A comprehensive literature search was performed in PubMed, Web of Science, and Cochrane databases up to January 2022. Inclusion criteria included randomized controlled trial (RCT) studies comparing VLP fixation with cast immobilization for DRFs. Investigated parameters were Patient-Rated Wrist Evaluation questionnaire, Disabilities of the Harm, Shoulder, and Hand score (DASH), range of motion (ROM), grip strength, quality of life (QoL), radiological outcome, and complication and reoperation rate, both at short- and mid-/long-term follow-up. Assessment of risk of bias and quality of evidence was performed with Downs and Black's 'Checklist for Measuring Quality'.
- *Results:* A total of 12 RCTs (1368 patients) were included. No difference was found for ROM, grip strength, QoL, and reoperation, while the DASH at 3 months was statistically better in the VLP group ($P < 0.05$). No clinical differences were confirmed at longer follow-up. From a radiological perspective, only radial inclination (4°) and ulnar variance (mean difference 1.1 mm) at >3 months reached statistical significance in favor of the VLP group (both $P < 0.05$). Fewer complications were found in the VLP group ($P < 0.05$), but they did not result in different reintervention rates.
- *Conclusions:* This meta-analysis showed that the surgical approach leads to a better clinical outcome in the first months, better fracture alignment, and lower complication rate. However, no differences in the clinical outcomes have been confirmed after 3 months. Overall, these findings suggest operative treatment for people with higher functional demand requiring a faster recovery, while they support the benefit of a more conservative approach in less demanding patients.

Keywords

- distal radius fracture
- DRF
- volar locking plate
- VLP
- cast immobilization
- cast reduction

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Introduction

Distal radius fractures (DRFs) are one of the most common fractures in the population accounting for about 17% of all fractures (1, 2). The incidence ranges from 73 to 202 per 100 000 in men and from 309 to 767 per 100 000 in women, with over 640 000 cases reported during 2001 in the United States alone (3, 4, 5). DRFs affect a wide population range, including both young people suffering from high-energy trauma, as well as the population aged >50 years, often suffering from falls from a standing height and other low-energy trauma (6, 7, 8, 9). Different treatment options have been developed through the years, the most common being non-operative closed reduction and cast immobilization (CR) or operative open reduction and internal fixation (ORIF) with volar locking plate (VLP) (10, 11). Each treatment has pros and cons: cast treatment requires longer recovery time and offers a less perfect radiological reduction of the fracture, but it is safer and more economic, on the opposite, ORIF is thought to offer good fracture alignment, faster clinical improvement, and early return to routine activities but at the price of surgical risks such as infection, cut-out, and higher costs (12, 13, 14, 15). Up to now, there is a lack of evidence and consensus in the literature regarding the best treatment for DRFs. Even the guidelines of the American Academy of Orthopedic Surgeons do not recommend for or against the conservative or surgical approach (16). Previous systematic reviews and meta-analyses on this topic either lack data or are based on heterogeneous studies of low quality, thus not leading to conclusive and solid evidence (12, 15, 17, 18).

The aim of this meta-analysis was to compare these two main treatment approaches for DRFs, evaluating which treatment brings a greater benefit in terms of functional scores, range of motion (ROM), and radiological outcomes. The secondary outcome was the comparison of the complication and reoperation rates of CR and VLP for the treatment of DRFs.

Materials and methods

Literature search

A review protocol was created based on the preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) statement (www.prisma-statement.org). The study was registered on PROSPERO (n° CRD42021233706). A literature search was performed in three bibliographic databases (PubMed, Web of Science, and Wiley Cochrane Library) from inception up to January 14, 2022. The following research terms were used '(radius OR radial OR wrist fract* OR Colles fract*) AND (plate OR ORIF OR fixation) AND (conservative OR nonsurgical OR non-surgical OR nonoperative OR non-operative OR cast OR splint OR plaster OR immobilisation).' Inclusion criteria included randomized controlled trials (RCTs) comparing VLP vs cast for the treatment of DRFs in adults, written in English language. Case reports or case series describing less than or equal to five cases and non-comparative articles were excluded. Pre-clinical and *ex vivo* studies and review articles were also excluded.

Data extraction

Two independent reviewers screened all the articles on the title and abstract to assess whether they met the inclusion criteria. After the first screening, the articles that met the inclusion criteria were evaluated for full-text eligibility and were excluded if they did not follow the inclusion criteria (Fig. 1). In case of disagreement between the two reviewers, a third reviewer was consulted to reach a consensus.

Data were independently extracted on a preconceived data extraction form using Excel (Microsoft). The following data were extracted: first author, journal, year of

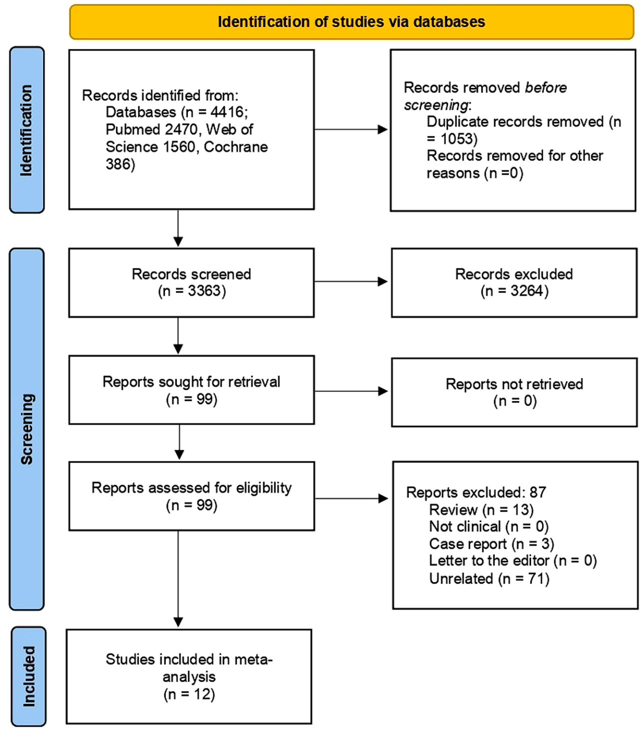

Figure 1
PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) flowchart.

publication, level of evidence, population characteristics, type of fracture, treatment, functional outcomes, radiological outcomes complications, and reinterventions. After independent data collection, the reviewers compared the extracted data.

Assessment of risk of bias and quality of evidence

The Downs and Black's 'Checklist for Measuring Quality' was used to evaluate the risk of bias (19). It contains 27 'yes'-or-'no' questions across 5 sections; it provides a numeric score out of 32 points (see Supplementary Appendix 1, see section on supplementary materials given at the end of this article). The 5 sections include questions about the overall quality of the study (10 items), the ability to generalize findings of the study (3 items), the study bias (7 items), the confounding and selection bias (6 items), and the power of the study (1 item). Assessment of risk of bias and quality of evidence was completed independently for all outcomes by two authors, and a third author solved any possible discrepancy.

Outcomes evaluated

Functional outcomes were evaluated through the Disabilities of the Arm Shoulder and Hand (DASH) questionnaire and the Patient-Rated Wrist Evaluation

(PRWE) questionnaire, reported at 3 and 12 months. Quality of life (QoL) was assessed by the EuroQol 5 Dimension (EQ-5D) tool, at 3 and 12 months.

Grip strength and ROM including extension, flexion, supination, pronation, and radial and ulnar deviation were analyzed at 3, 6, and 12 months.

The radiographic measures were step off, ulnar variance and palmar tilt (millimeter), and radial inclination (degrees). These outcomes were evaluated in the immediate postoperative period and at 3 months or over. Finally, complications and reintervention rates by treatment groups were reported. The complications occurring after the two different treatment groups were subdivided into minor and major according to a validated complication checklist developed by McKay *et al.* (19). Complications not requiring surgical treatment or further investigations in the studied populations were graded as minor (e.g. superficial wound infections, complex regional pain syndrome (CRPS), steroid injection, and physiotherapy). Major complications included nerve or tendon injury, deep infections, and hardware failure that led to reoperation.

Statistical analysis

The statistical analysis and the forest plot were carried out according to Neyeloff *et al.* (20) using Microsoft Excel by an independent professional statistician. The Mantel–Haenszel method was used to provide pooled rates across the studies. A statistical test for heterogeneity was first conducted with the Cochran Q statistic and I2 metric and was considered the presence of significant heterogeneity with I2 values ≥25%. When no heterogeneity was found with I2 <25%, a fixed effect model was used to estimate the pooled rates and 95% CIs. Otherwise, a random effect model was applied, and an I2 metric was evaluated for the random effect to check the correction of heterogeneity. The studies' rate confidence intervals were carried out using the continuity-corrected Wilson interval. All statistical analysis was carried out with Microsoft Excel 2010.

Results

Details of the included studies

A total of 4416 articles were retrieved; after the removal of duplicates and screening of the titles, abstracts, and full-texts, 12 RCTs were included in the meta-analysis (Fig. 1). In this study, 1368 patients (424 men and 944 women) were included, 683 (30.3% men, 69.7% women) in the CR group and 685 (31.4% men, 68.6% women) in the ORIF group; the mean age was 70.5 years old in the operative group and 70.9 in the non-operative group. A total of 11 studies reported the mean follow-up (13.4 months) (see Table 1 for further details, Fig. 2).

Patient-reported outcomes

The DASH score was used in eight studies at 3 months and in ten studies at ≥12 months (21, 22, 23, 24, 25, 26, 27, 28, 29). A statistical difference was found between the conservative and surgical groups at 3 months ($P < 0.05$), with the mean difference (MD) of 9.9 points in favor of the ORIF group. The plate group had a mean value of 15.1 points (95% CI: 11.5–18.7) and the cast of 25.06 (95% CI: 22.9–27.2). The difference was not maintained at 12 months, when DASH scores presented only a 3.7 point higher score, with no statistically significant difference (Table 2) (see Supplementary Appendix 2 for further details).

The PRWE was used at 3 and ≥ 12 months by four studies. Patient-reported scores were higher in the ORIF group, 12 points and 4.4 points more than the CR group at the 2 follow-ups, respectively, although without reaching a statistically significant difference (Table 2).

Quality of life

The EQ-5D was reported by four studies, at both short (3 months) and long term (12 months) (23, 26, 28, 30). The MD of the EQ-5D at 3 months was 5% (P = n.s.) in favor of the CR group compared with the ORIF. At >12 months, the MD decreased at 2% (P = n.s.) in favor of the CR group. However, no statistically significant difference was reached in the EQ-5D at 3 and ≥12 months between the groups (Table 2).

Range of motion

ROM was analyzed at 3, 6, and 12 months in extension, flexion, pronation, and supination, by 7, 5, and 8 studies, respectively, and in radial and ulnar deviation by 6, 5, and 7 studies (Table 2) (31, 23, 24, 25, 26, 27, 28). No statistically significant difference for any of the ROM parameters was found between the two treatments, at all-time points.

Grip strength

Grip strength, measured as the difference with respect to the healthy contralateral arm, at 3 months was reported by seven studies, and the MD between the two treatments was 13.6% (P = n.s.); at 6 months, as reported by five studies, the MD was 9.9 % (P = n.s.); finally, at 12 months grip strength was reported by eight studies, and the MD was 8.3% (P = n.s.). While the grip strength values were generally higher in favor of the VLP fixation group at all the considered time points, no statistically significant difference was reached between the two groups (Table 2) (21, 23, 24, 25, 26, 27, 28, 31).

Table 1 Details of the included studies.

Reference	Country	Participants, *n*			Age (range)*	Patients with plate/cast		AO classification, plate/cast			Time points	RoB score
		Total	Male	Female		*n*	Age (range)*	A	B	C		
Arora *et al.* (24)	Austria	73	18	55	75.9 (65–88)	36/37	77.4 (65–89)	10/12	0/0	26/25	6 and 12 weeks, 6 and 12 months	26
Bartl *et al.* (23)	Germany	174	21	153	75 (N/A)	86/88	74.4 (N/A)	0/0	0/0	86/88	3 and 12 months	25
Hassellund *et al.* (28)	Norway	100	11	89	73.4 (65–91)	50/50	73.9 (65–88)	12/14	0/0	38/36	3, 6 and 12 months	26
Kapoor *et al.* (33)	India	62	45	17	N/A	29/33	(N/A)	N/A	N/A	N/A	N/A	15
Lawson *et al.* (30)	Australia	166	21	145	70.5 (60–86)	81/85	71.3 (60–90)	55/49	0/0	26/35	3 and 6 months	30
Martinez-Mendez *et al.* (32)	Spain	97	21	76	67 (60–80)	50/47	70 (60–80)	0/0	0/0	50/47	2 and 6 weeks, 6, 12, and >24 months	23
Mulders *et al.* (21)	Netherlands	90	23	67	59 (42–66)	47/43	60 (52–65)	47/43	0/0	0/0	1, 3, and 6 weeks, 3, 6, and 12 months	29
Saving *et al.* (26)	Sweden	122	11	111	80 (70–90)	58/64	78 (70–98)	39/38	0/0	19/26	3 and 12 months	28
Selles *et al.* (22)	Netherlands	90	14	76	59 (53–67)	44/46	62 (49–66)	0/0	0/0	44/46	6 weeks, 3, 6, and 12 months	28
Sharma *et al.* (29)	India	64	26	38	52 (25–55)	32/32	48 (25–55)	0/0	15/13	17/19	6 weeks, 3, 6, 12, 18, and 24 months	21
Sirniö *et al.* (27)	Finland	80	76	4	62 (50–79)	38/42	64 (50–82)	23/25	0/0	15/17	3, 6, 12, and 24 months	25
Tahir *et al.* (25)	Pakistan	159	126	33	81 (N/A)	87/72	81 (N/A)	59/41	0/0	28/31	3 and 12 months	30

*Mean age.
N/A, not assessable; RoB, risk of bias.

Radiological assessment

Radiographic outcomes were generally better for the ORIF group, but only radial inclination and ulnar variance at ≥3 months were statistically significant in favor of the ORIF group (see Supplementary Appendix 2 for further details). The palmar tilt projection in the post-op period was reported by four studies: in the ORIF group, it was 5.5° and in the CR group 4.0°, with a 1.4° MD (*P* = n.s.), and at ≥3 months, it was reported by six studies: the MD was 1.3° (*P* = n.s.) (22, 23, 24, 26, 28, 30). Radial inclination in the post-op period was reported by six studies with 0.8° MD (*P* = n.s.) and at ≥3 months, it was reported by eight studies, showing a statistically significant difference of 4° in favor of the ORIF group (*P* < 0.5) (22, 23, 24, 25, 26, 27, 28, 30). Ulnar variance in the post-op period was reported by six studies: the MD was 0.3 mm (*P* = n.s.). Evaluation at ≥3 months was reported by eight studies: in the ORIF group, it was 1.0 mm and in the cast group, it was 2.1 mm, and the MD 1.1 mm was statistically significant (*P* < 0.5). No differences were found for step-off both in the postoperative period (three studies) and at ≥3 months (four studies) (Table 2) (22, 23, 24, 25, 26, 27, 28, 30).

Complications

Eleven studies reported the complication rate: 12.4% (88 patients out of 606) in the ORIF group and 24.1% (171 patients out of 605) in the CR group; the difference was statistically significant in favor of the ORIF group (*P* < 0.05). The main major complication in the CR group was the loss of reduction (23.7% of all complications), which was not seen in the ORIF group. The incidence of malunion was higher in the CR group (17.5% of all complications) compared with the VLP fixation group (2.2%). The main major complication in the VLP fixation group (15.6% of all complications) was carpal tunnel syndrome, while in the CR group, accounted for 10.1% of all complications (Table 3 for further details) (21, 22, 23, 24, 25, 26, 27, 28, 30, 32, 33).

Reinterventions

All the articles except one reported the number of reinterventions. In the ORIF group, 56 reinterventions were reported out of 606 patients (6.4%). In the cast group, 93 reinterventions were reported out of 606 patients (9.5%), without a statistically significant difference between the two groups (*P* = n.s.). The main cause of reintervention in the CR group was the loss of reduction (33 of 93) and in the VLP fixation group was patients' willingness of removal (27 of 56) (21, 22, 23, 24, 25, 26, 27, 28, 30, 32, 33).

Risk of bias

The Downs and Black's tool for assessing the risk of bias gives each study an excellent ranking for scores ≥26, good

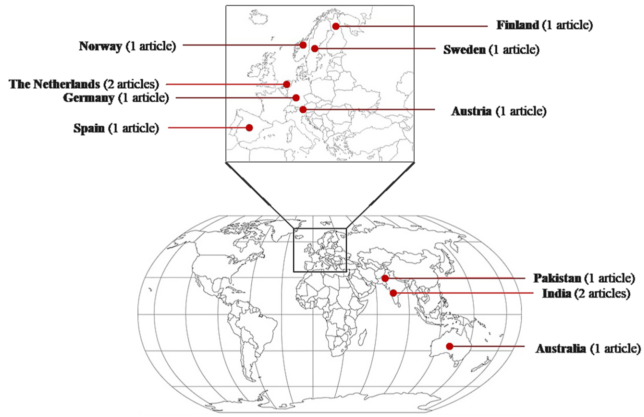

Figure 2
Countries of origin of the 14 articles comparing cast vs plate on the DRFs.

for scores from 20 to 25, fair for scores between 15 and 19, and poor for scores ≤14 points. Among the included studies, zero studies were classified poor, one fair, four good, and seven excellent (Fig. 3). Mostly, the factors reducing the quality of the studies were confounders, un-blinding assessment, and low statistical power of some studies.

Discussion

The main finding of this systematic review and meta-analysis is that the surgical approach leads to a faster functional recovery, better fracture alignment, and fewer complications, although no overall clinical differences were found between ORIF and cast in the long term. In this meta-analysis, the most commonly used questionnaire was the DASH score, which was able to underline a statistically significant difference between the two treatments only at 3 months in favor of the operated group. At 12 months, the difference between the two groups decreased, becoming not significant. The same trend was observed by the PRWE score, although no statistically significant difference was reached at any time point. These results support a faster recovery in the operated patients. Previous literature already investigated this aspect. Lawson *et al.* performed a systematic review and meta-analysis showing the same trend in functional scores. However, the authors were not able to find a significant difference between the DASH scores at 3 months in the two groups, which could be explained by the lower population retrieved (18). The current meta-analysis instead was able to analyze a larger number of RCTs, showing in a larger population that the patient reported difference in terms of functional score at 3 months was statistically significant. Some authors reported that this statistically significant difference was maintained over time, at 12 months for the study of Saving *et al.* (26), and up to 24 months (25) in the study of Martinez-Mendez *et al.*, who pointed out that this result could be due to a longer mean plaster time and subsequent longer mean recovery time for the conservative group (32).

This meta-analysis did not confirm a persisting difference over time. However, the documented faster recovery after surgery is of clinical relevance, as it could be important for some categories of patients, such as elderly patients for whom the fast recovery of self-sufficiency is crucial, as well as for people in paid employment or people living without caregivers, or even more in sport-active patients and competitive athletes. On the other hand, the small advantages in terms of faster recovery should be also weighted in terms of health care costs. For example, Tahir *et al.* reported overall costs of 12 033 USD for the surgical management (25), while Navarro *et al.* quantified in 137 USD the cost of the conservative cast treatment (15).

Another finding of the current meta-analysis is that the final ROM was not different between the conservative and surgical approaches. This has been a controversial finding in the literature (34). This meta-analysis showed that the operative treatment does not seem to offer better ROM results. The ORIF group was also found to have only a marginally higher grip strength at 3 and 12 months of follow-up when compared to the conservative treatment, and this difference was not statistically significant and did not limit functional recovery and daily life activities (17, 24, 30, 35, 36). Stephen *et al.* pointed this out in their retrospective study (36). Since no treatment prevails in terms of clinical outcomes, the surgeon's choice of treatment should be based on the age, occupation, and functional demands of each patient. For example, the risks of exposing elderly or medically vulnerable patients to operative treatment and hospitalization may encourage non-operative treatment given the support of the literature on its effectiveness.

Radiological outcomes are widely used both in the pre-treatment evaluation of DRFs to choose the proper treatment and after reduction to assess the restoration accuracy and resolution of the fracture rhyme. In this study, ORIF for the treatment of DRFs was associated with better radiological outcomes when compared to immobilization with cast in terms of radial inclination and ulnar variance. An *ex vivo* radiographic study of Pogue *et al.* described how a large change in volar tilt causes an alteration in wrist joint mechanics. In detail, a decrease in this angle leads to more load in the lunate fossa and less load in the scaphoid fossa (37). However, although statistically significant, the low absolute values of radiographic changes documented by this meta-analysis were of questionable clinical significance, which may explain the lack of clinical difference over time. In fact, as already discussed in the previous paragraphs, the better radiographic alignment seen in the ORIF group did

Table 2 *P*-value of the relative outcome.

Outcome	Studies, *n*	Patients, *n*		Mean (95% CI)		*P*-value
		Plate	Cast	Plate	Cast	
Clinical						
EQ-5D						
3 months	4	275	287	0.8 (0.7–0.9)	0.8 (0.7–0.9)	0.27
12 months	4	275	287	0.8 (0.7–0.9)	0.8 (0.7–0.9)	0.37
DASH						
3 months	8	446	442	15.1 (11.5–18.7)	25. (22.9–27.2)	0
12 months	10	559	559	8.15 (5.1–11.2)	11.9 (9.5–14.2)	0.06
PRWE						
3 months	7	403	397	25.3 (10.8–39.8)	37.3 (26.3–48.2)	0.17
12 months	7	403	397	9.0 (5.4–12.7)	13.5 (9.2–17.8)	0.12
Grip strength						
3 months*	7	360	354	64.8 (51.4–78.2)	51.2 (35.5–66.9)	0.17
6 months*	5	215	218	73.3 (45.5–101)	63.4 (39.9–86.8)	0.34
12 months*	4	392	386	82.4 (65.1–99.6)	74.1 (60.9–87.5)	0.3
Radiological						
Palmar tilt						
Post-operation	4	193	183	5.5 (0.7–10.3)	4.0 (0.0–8.5)	0.6
>3 months	6	329	318	5.1 (2.3–7.9)	3.8 (1.9–5.7)	0.3
Radial inclination						
Post-operation	6	301	297	20.6 (19.6–21.6)	19.8 (18.3–21.3)	0.27
> 3 months	8	437	432	21.0 (18.7–23.4)	16.9 (14.5–19.4)	0.02
Ulnar variance						
Post-operation	6	301	297	0.5 (0.2–0.9)	0.8 (0.6–1.0)	0.14
>3 months	8	437	432	0.9 (0.5–1.4)	2.0 (1.1–3.0)	0.04
Step off						
Post-operation	3	173	159	0.5 (0.1–0.9)	0.6 (0.0–1.2)	0.38
>3 months	4	223	206	0.5 (0.2–0.8)	0.8 (0.5–1.1)	0.18
Range of motion						
Extension						
3 months	7	360	354	56.7 (43.8–69.7)	53.6 (46.4–60.7)	0.36
6 months	5	215	218	67.2 (57.9–76.5)	65.8 (57.2–74.4)	0.38
12 months	8	392	386	68.3 (61.7–74.8)	65.9 (60.3–71.5)	0.34
Flexion						
3 months	7	360	354	52.9 (43.2–62.6)	46.9 (39.2–54.7)	0.25
6 months	5	215	218	63.3 (55.0–71.6)	56.4 (47.6–65.2)	0.21
12 months	8	392	386	65.3 (57.0–73.5)	58.8 (52.6–64.9)	0.18
Radial deviation						
3 months	6	273	282	17.5 (14.9–20.0)	16.8 (12.9–20.8)	0.38
6 months	5	215	218	17.3 (14.1–20.5)	17.2 (13.7–20.7)	0.39
12 months	7	305	314	26.6 (15.6–37.7)	24.6 (17.7–31.4)	0.37
Ulnar deviation						
3 months	7	359	370	26.2 (23.4–28.9)	22.7 (19.7–25.7)	0.9
6 months	5	215	218	26.8 (22.6–30.9)	24.2 (21.6–26.8)	0.23
12 months	7	305	314	34.7 (21.3–48.2)	30.6 (22.4–38.8)	0.34
Supination						
3 months	7	360	354	79.9 (76.1–83.8)	74.9 (68.2–81.6)	0.17
6 months	5	215	218	83.4 (82.3–84.5)	77.3 (74.6–79.7)	0.28
12 months	8	392	386	80.6 (72.9–88.2)	77.4 (66.5–88.3)	0.35
Pronation						
3 months	8	446	442	82.8 (79.3–86.3)	81.0 (77.8–84.3)	0.3
6 months	5	215	218	84.9 (82.1–87.9)	82.9 (79.8–85.7)	0.24
12 months	9	478	474	68.9 (57.8–81.1)	77.5 (62.4–92.7)	0.26

*% respect the counter side.
DASH, Disabilities of the Arm and Shoulder questionnaire; EQ-5D, EuroQol 5 Dimension tool; PRWE, Patient-Rated Wrist Evaluation questionnaire.

not translate into better ROM, function, and grip strength at the final evaluation. This is an important finding since it underlines the fact that radiological perfect reduction, which is often one of the main factors justifying a surgical treatment, is not necessary for the patient's satisfaction in the everyday life. Further comparative studies should be conducted to address this question and verify if the results are maintained at long-term follow-up, as well as the potential benefit in particular subcategories of patients (12, 17, 18, 23, 24, 28, 36).

Another fundamental aspect to be considered when choosing between surgical and conservative treatments is the risk of complications. The previous literature shows conflicting findings with the review by Chen *et al.* reporting a statistical difference only in the major complications requiring surgical treatment, more

Table 3 Summary of the total complications; the numbers are the percentage of each complication, out of the total, for each approach.

Complications	ORIF	CR
Major		
CTS	15.6%	11.0%
Nerve injury	11.5%	5.6%
Deep infection	4.1%	0.0%
Tendon rupture	6.3%	1.9%
Malunion	2.2%	17.5%
Non-union	1.0%	1.9%
Lost reduction	0.0%	23.7%
Osteotomy	0.0%	5.2%
Other	3.1%	1.4%
Minor		
Tendon irritation	18.7%	1.9%
Superficial infection	6.3%	1.9%
Finger stiffness	8.3%	8.9%
Malposition of implant	7.3%	0.0%
CRPS	6.3%	11.0%
Pain	5.2%	8.1%
Scar injury	4.1%	0.0%

CTS, carpal tunnel syndrome; CR, cast immobilization; ORIF, open reduction and internal fixation.

common in the conservative group but not in the minor complications group (17). Lawson *et al.* described a generally a lower complication rate for VLP fixation, while other meta-analyses found no difference or even a lower rate in the CR group (18). However, major limitations of these review studies are that they did not analyze only RCTs or they were limited to a low number of studies, thus making their results weaker, more prone to bias and less reliable (12, 17, 18, 36). This meta-analysis focused on a higher number of studies, selecting only RCTs, and found a statically significant difference in the complication rate between the two groups, with the VLP treatment causing fewer complications. However, it is important to stress the fact that most complications did not require surgical treatment. In fact, no difference in the reintervention rate was found.

Two clinical practice guidelines for the treatment of DRFs were published by two national organisations: the British Society for Surgery of the Hand (38) recommended conservative treatment as the primary option after careful consideration of patient characteristics, while the Norwegian Orthopaedic Association (39) recommended the surgical treatment in adults, with a weak recommendation in patients over 65 years old. In the present study, no sub-analyses were performed on age-related outcomes, since the RCTs retrieved were too few to be compared for age groups. However, important findings were derived for the general population: operative treatment may have some advantages in the short term for people with higher functional demand, while there is no benefit after the first months. Unfortunately, there are not enough data to state which treatment is better at a longer follow-up, and future studies should investigate the long-term consequences of the documented radiographic changes after conservative treatment in terms of radial inclination and ulnar variance.

Despite the high quality of the retrieved studies and the large number of patients analyzed, the current study has some limitations. First of all, the follow-up is limited to 12 months, although the only study with >12 months of follow-up found that functional outcomes did not change significantly after the first year (33). Second, because of the heterogeneity of the data, it was not possible to carry out further comparative sub-analyses such as those between different age groups. Moreover, only RCTs in English were included, which can be a bias. Finally, no studies used the Patient-Reported Outcomes Measurement Information System, which would have been an interesting and useful tool to compare different treatments. However, this study also presents strengths in terms of number of higher number of studies and patients evaluated with respect to previous literature analyses. In fact, this topic is becoming much debated and of important clinical interest in recent years, as evidenced by the 4 RCTs released in 2021 out of 12 included in this meta-analysis. The inclusion of only RCTs Is another strength of this study This comprehensive review and meta-analysis compared the two main treatments for DRFs and offered important indications that could be used for future studies and guidelines to clarify this debate. In addition, these results can offer important guidance for hand and trauma surgeons by suggesting potential and limitations of the two main approaches to treat DRFs.

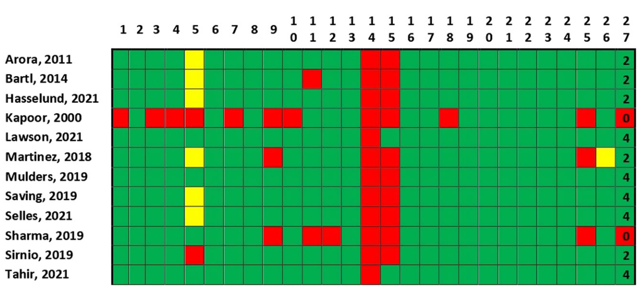

Figure 3
Downs and Black's tool for assessing the risk of bias. For the explanation of each column question, see Supplementary Appendix.

Conclusion

This meta-analysis showed that the surgical approach leads to a better clinical outcome in the first months, better fracture alignment, and lower complication rate. However, no differences in the clinical outcomes have been confirmed after 3 months. Overall, these findings suggest operative treatment for people with higher functional demand requiring a faster recovery, while they support the benefit of a more conservative approach in less demanding patients.

Supplementary materials
This is linked to the online version of the paper at https://doi.org/10.1530/EOR-22-0022.

ICMJE Conflict of Interest Statement
The authors declare that there is no conflict of interest that could be perceived as prejudicing the impartiality of the work reported here.

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