TITLE PAGE

TITLE OF ARTICLE:

Developing a core outcome set for hand fractures and joint injuries in adults: a systematic review of treatment outcomes

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KEYWORDS:

Hand fractures; joint injuries; core outcome set; treatment outcomes; systematic review

CONFLICTING INTERESTS:

The author(s) declare no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

INFORMED CONSENT

Not applicable

ETHICAL APPROVAL

Not applicable

CORE OUTCOME SET FOR HAND FRACTURES AND JOINT INJURIES IN ADULTS

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CONTRIBUTORSHIP

SRD, AK, AAM and PL conceived the study. SRD, DG, AK, AAM, PL, CJ-H, JNR and RT developed the protocol. SRD, DG and AK were involved in screening of search results. SRD, CM and BM conducted data extraction and analysis. SRD wrote the first draft of the manuscript. All authors reviewed and edited the manuscript and approved the final version of the manuscript.

FUNDING STATEMENT:

This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors. SRD is funded by PhD studentship at the CEBHS, University of Nottingham, which receives funds from the British Society for Surgery of the Hand.

BM is funded by a National Institute for Health Research (NIHR) Doctoral Fellowship (NIHR300240) and JNR is funded by a National Institute for Health Research (NIHR) Postdoctoral Fellowship (PDF-2017-10-075). This paper presents independent research funded by the National Institute for Health Research (NIHR). The views expressed are those of the author(s) and not necessarily those of the NHS, the NIHR or the Department of Health and Social Care.

TITLE

Developing a core outcome set for hand fractures and joint injuries in adults: a systematic review of treatment outcomes

ABSTRACT

This study identifies the treatment outcome domains used in recently published studies on the treatment of hand fractures and joint injuries, to inform development of a core outcome set. Seven databases were searched from January 2014 to March 2019 for randomized and quasi-randomized studies and large prospective observational studies. We identified 1777 verbatim outcomes in 160 eligible studies. From the verbatim outcomes we distinguished 639 unique outcomes which we categorised into 74 outcome domains based on the World Health Organization International Classification of Functioning, Disability, and Health framework. The primary outcome was appropriately identified in only 65% (72/110) of randomized and quasi-randomized controlled trials. Of the 72 studies with a primary outcome identified, 74% (53/72) had an appropriate power calculation. The vast heterogeneity in outcome selection across studies highlights the need for a core outcome set of what outcomes to measure in future clinical research on hand fractures and joint injuries.

INTRODUCTION

The recent James Lind Alliance Priority Setting Partnership on common conditions affecting the hand and wrist incorporated the opinions of patients, carers and clinicians. It highlighted the need for research to answer uncertainties concerning both the treatment of injuries in the hand and wrist and the methods of best assessing patient outcomes from treatment (James Lind Alliance, 2017). Outcome selection is a fundamental aspect of clinical research. However, when different researchers select outcomes independently, there is the risk of inconsistency in outcomes used across studies. There is also the risk that researchers omit outcomes of priority to patients themselves (Kirwan et al., 2003).

A core outcome set (COS) is an agreed minimum set of outcomes that should be measured and reported in all clinical trials or research studies in a specific area of health (Williamson et al., 2017). It should have input from key stakeholder groups including healthcare professionals but also patients. Use of a COS increases consistency across studies, allowing more trials to be included in future meta-analyses and helping to measure clinically relevant outcomes. Selective reporting bias is also reduced since it becomes apparent if COS outcomes are not fully reported.

The aims of this systematic review were to:

1. Identify and map the outcome domains measured in recent clinical studies of hand fractures and joint injuries
2. Assess selective outcome reporting bias in these studies
3. Compare outcome domains reported on the treatment of patients with distal radial fractures (DRF) versus other hand and wrist injuries (non-DRF). Epidemiological studies have indicated a difference in the typical age and sex distribution of the patient populations of DRF and non-

DRF injuries (Karl et al., 2015; Van Onselen et al., 2003; Van Staa et al., 2001). Such differences may influence outcome selection by researchers.

METHODS

The design of this systematic review was guided by the Core Outcome Set-STAndards for Development (COS-STAD) (Kirkham et al., 2017). The protocol was prospectively registered on the PROSPERO international prospective register of systematic reviews (CRD42019126299).

Scope and eligibility criteria

We defined hand fractures and joint injuries as phalangeal, metacarpal, carpal or distal radial fractures (with or without distal ulna) or an injury to a joint between any of these bones. These injuries included dislocation, subluxation, volar plate injury, avulsion injury, ligamentous tears/sprains/ruptures, and closed tendon ruptures/tears.

We excluded complex hand injuries (i.e. 'mangled hand', amputations requiring replantation), primary nerve injuries, burns and open tendinous injuries, as such injuries likely have very different outcome domains of interest.

Study types included randomized controlled trials (RCTs) and pilot or feasibility studies, quasi-randomized controlled trials (qRCTs) and prospective observational studies with ≥100 patients. Detailed inclusion and exclusion criteria are outlined in Online Table S1.

Study identification

We compiled search strategies under guidance of an information specialist experienced in the hand surgery literature (DG). Key search strategy concepts were:

1. Bones, joints, tendons and ligaments of the hand, carpus and distal radial

2. Generic terms for fractures and joint injuries
3. Specific hand fracture and joint injury terms

We combined [1] and [2] with AND, then added to these by combining with [3] using OR.

We identified relevant free text terms and subject headings for each database. Databases searched were Ovid MEDLINE, Ovid Embase, Cochrane Central Register of Controlled Trials (CENTRAL), PubMed, CINAHL (EBSCO), PEDro and Ovid PsycINFO.

We conducted a staged search strategy as outlined in the COMET Initiative handbook (Williamson et al., 2017), with initial search run on 29/03/2019. An example of the search strategy and descriptions of the staged search method and study selection process are provided in Online Appendix S1.

Risk of bias assessment

We determined the outcomes captured by studies rather than the quantitative results obtained. However, selective outcome reporting can offer insight into which outcomes authors truly prioritise. Kirkham et al. (2010) describe an outcome matrix for the assessment of outcome reporting bias (ORB) based on the premise that any outcome specified for inclusion should be reported in the final publication. We used a modified version of this, as summarised in Online Table S2.

We deemed the primary outcome to be one of the following (in descending order):

i. The outcome upon which the study sample size calculation was based
ii. The primary outcome specified in the study
iii. The outcome which appeared to correspond most closely with the study aim

If there was no clear primary outcome, we considered all outcomes in the study as secondary outcomes.

We performed independent two-reviewer assessment of outcome reporting status (SRD for all outcomes, second assessment divided between CM and BM).

We excluded generic 'adverse event' or 'complication' outcomes from the assessment, except in cases where specific named complications were identified as being standalone study outcomes.

Data synthesis

We analysed all extracted verbatim outcomes for similarity in meaning through discussion (SRD for all, and either CM or BM). "Verbatim outcome" means the literal outcome. For example, "finger flexion" and "flexion of the finger" would technically constitute different "verbatim outcomes" but one unique outcome if measured in the same way. We split verbatim outcomes with similar terminology but different meaning into two unique outcomes where results for these outcomes could not be reasonably pooled in a meta-analysis. For example, "finger flexion" constitutes two unique outcomes if reported in degrees of joint movement in some studies but as a percentage compared to the contralateral limb in others. We categorised unique outcomes into domains based on the World Health Organization International Classification of Functioning, Disability, and Health (WHO ICF) framework (World Health Organization, 2001), using the WHO ICF linking rule guide (Cieza et al., 2005).

We analysed patient-reported outcome measure (PROM) instruments by categorising the individual items and components of any scales into WHO ICF outcome domains (Macefield et al., 2014).

Time points of outcomes are often heterogeneous. To determine 'meaningful' heterogeneity resulting from use of multiple and varying time points for outcome assessment, we created time

point ‘ranges’ representing typical ‘follow-up windows’ and categorised our findings according to these ‘ranges’.

RESULTS

Figure 1 shows the PRISMA study flow diagram (Moher et al., 2009).

A table of all 160 included studies is provided in Online Appendix S2. Most studies were single-centre and based in Europe and Asia (Table 1). A total of 20228 participants were recruited from 39 countries. Most studies were RCTs. The primary outcome was appropriately identified in 65% (72/110) of RCTs and qRCTs. Of those 72 studies with a primary outcome identified, 74% (53/72) had an appropriate power calculation.

Outcomes

There were 1777 verbatim outcomes. The number of outcomes reported per study varied from 1 to 36, with a median of ten outcomes (interquartile range 6 to 14). Verbatim outcomes were deduplicated and rationalised to 639 unique outcomes. Of these unique outcomes, 71% (456/639) were used in only a single study, 20% (128/639) were used in only two to four studies and just 8.9% (57/639) were used in five or more studies.

Clinicians and healthcare professionals were the outcome assessors for 66% (1181/1777) of verbatim outcomes (Figure 2). There was heterogeneity in time point ‘range’ for outcome assessment as summarised in Table 2. The modal time point ‘range’ was 6 weeks to 6 months (28% of verbatim outcomes, 1109/3936).

Outcome domains

We mapped the 639 unique outcomes to 74 outcome domains using the WHO ICF framework (World Health Organization, 2001). The presence of each outcome domain in individual studies was noted; further details are depicted in Online Appendix S3.

While many of the unique outcomes linked to a single WHO ICF domain, some (in particular PROMs) linked to multiple domains. Certain outcomes did not map onto the framework at all, the most common being adverse events/complications (58% of studies, 93/160), patient satisfaction (24% of studies, 38/160) and bone healing (23% of studies, 36/160).

Comparison of distal radial fractures and non-DRF studies

There were 121 (76%) studies involving mainly patients with DRFs. Table 3 summarises the age and sex distribution of participants in DRF studies as compared to non-DRF studies.

PROMs were used in 79% (96/121) of DRF studies and 92% (36/39) of non-DRF studies. Table 4 shows the five most common PROMs and ten most common outcome domains used, and their frequency in DRF compared to non-DRF studies. The Visual Analog Scale (VAS) for pain was the most commonly reported PROM overall (41% of studies, 66/160). The DASH was second most common PROM for DRF studies (38% of studies, 46/121) and the QuickDASH was second commonest PROM for non-DRF studies (12/39). The most common outcome domain for both DRF and non-DRF studies was 'sensation of pain' (92% of studies, 147/160) and second commonest was 'mobility of joint functions' (86% of studies, 137/160).

Outcome reporting bias

Figure 3 depicts the reporting status of outcomes across the different study types, with RCTs and qRCTs subdivided based on trial registration status. This reflects the reporting bias for these outcomes. Of the RCTs and qRCTS, only 20% (22/110) were prospectively registered. Fewer than

half of the outcomes in RCTs and qRCTs and two-thirds in prospective observational and randomized pilot/feasibility studies were 'completely' reported.

DISCUSSION

This review reveals several fundamental methodological issues in outcome selection for clinical research on hand fractures and joint injuries. It is important to raise awareness of these issues amongst hand surgeons, who will form a key stakeholder group in any future consensus work.

A wide range of heterogeneous outcome domains and outcome time points are reported in the recent literature on hand fractures and joint injuries. Such variation hinders meta-analysis and predisposes to 'research waste' (Ioannidis et al., 2014; Yordanov et al., 2018).

The high number of unique outcomes is partially explained by the broad scope of injuries being covered. However, even at the more fundamental outcome domain level we identified 74 distinct domains. Only three domains were reported in over 75% of studies; 'sensation of pain', 'mobility of joint functions' (range of movement) and 'muscle power function' (grip/pinch strength, performing certain actions). Even these were measured in a variety of ways and at various time points, hindering or precluding meta-analysis.

A prior study limited to a small selection of journals found that 'objective clinical measures' (e.g. grip strength, range of motion, functional status), 'quality of life' and morbidity were the commonest outcomes assessed (Chung et al., 2006). Weinstock-Zlotnick and Mehta (2016) reported on outcomes for wrist fractures and ligament injuries from RCTs between 2005 and 2015. Though lacking details in terms of WHO ICF outcome domains, they found 'range of movement', 'grip strength' and 'pain' were the commonest physical outcome measures used, while DASH and

PRWE were the commonest PROMs. Their findings are in broad agreement with ours, indicating that priorities in outcome selection for studies preceding our search window were similar.

Goldhahn et al. (2014) undertook a literature review as part of a process which aimed to establish a core set for DRF. Though highlighting some commonly used outcomes, they did not present detail on the heterogeneity of outcomes identified. They found that 'radiological outcomes' (e.g. healing and alignment), 'grip strength', 'range of motion' and 'pain' were commonest, present in 68%, 49%, 49% and 38% of studies respectively. The 'pain' outcome was used much less commonly than the near-universal use we found. The frequency of 'radiological outcomes' is higher than we found but this is because they combined outcomes that we considered distinct domains of 'healing' (bone healing) and 'alignment' (structure of upper extremity).

We compared outcome selection in DRF and non-DRF studies and found considerable overlap. Though the rank order of commonest PROMs and outcome domains varied slightly, the top five PROMs and top ten outcome domains were the same (Table 4). Hence similar outcomes appear to be considered relevant to both populations.

However, most PROMs reflect multiple domains giving rise to greater apparent overlap. The commonest multi-domain PROMs used were DASH (Hudak et al., 1996), PRWE (MacDermid et al., 1998) and QuickDASH (Beaton et al., 2005). DASH captures all of the ten commonest outcome domains, while PRWE and QuickDASH each capture eight of the ten commonest domains used (except for 'mobility of joint functions' and 'muscle power functions').

Outcome reporting bias

The International Committee of Medical Journal Editors has deemed prospective trial registration in a public registry a condition for publication since 01/07/2005 (De Angelis et al., 2004). The updated Consolidated Standards of Reporting Trials statement (CONSORT) in 2010 contains clear

recommendations for registration and outcome reporting (Schulz et al., 2010). Despite these standards being set, (Lee et al., 2018) found that only 31% (28/90) of RCTs on distal radial fractures were registered. Only 16 trials specified a primary outcome measure at registration and seven of these ended up reporting either a different/additional primary outcome or none at all.

We found marked selective reporting bias in the recent literature of hand fractures and joint injuries, in agreement with previous studies of different populations. Many outcomes were not reported at all despite being specified in the publication or trial registration. Multiple others were reported incompletely, with only a brief comment or lacking sufficient detail for meta-analysis. All represent non-adherence to reporting standards.

We also found 'unexpected' outcomes, with 'duration of surgery' being the commonest. The prospectively registered studies had a lower proportion of 'unexpected' outcomes as compared to retrospectively registered trials. It is possible that prospective registration correlates with a higher methodological quality in general, which is reflected in this marker of ORB. An assessment of overall study design and risk of bias across all domains was beyond the primary scope of this study.

Other reviews of hand fractures and joint injuries have highlighted issues of "inadequate outcome assessment" and "large variation in reported outcomes" (Handoll and Vaghela, 2004; Poolman et al., 2006; Verver et al., 2017). This review specifically quantifies the magnitude of the problem.

One limitation of this review was the exclusion of studies for which a publication in English could not be obtained (n=22, Figure 1). However, for almost every country of origin where this occurred there were other studies with an English publication available maintaining some representation of these countries in the review. A theoretical limitation was the date range used, but we made this

choice to focus on outcomes used in the more recent literature through a 'staged search' approach, as recommended by the COMET Initiative (Williamson et al., 2017).

This review contributes to a longlist of outcome domains, laying the foundations for COS development. The next step is to formally and extensively explore the patients' perspective, through interviews and focus groups with those who have first-hand experience of these injuries. Information from both will be processed through consensus work in the form of a Delphi study and a final consensus meeting. Key stakeholders will be involved throughout to develop a COS of what key outcomes should always be reported in all future studies of the treatment of hand fractures and joint injuries, improving the evidence-base that guides clinical practice.

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FIGURE LEGENDS

Figure 1 PRISMA Flow Diagram

Figure 2 Pie chart demonstrating number and proportion of outcomes by assessor category PROM – patient-reported outcome measure; PRO – patient-reported outcome; PBOM – performance-based outcome measure

Figure 3 Cumulative bar chart showing percentage and number of outcomes within each reporting bias category across study types

SUPPLEMENTARY MATERIAL

Table S1 Inclusion and exclusion criteria for studies

Table S2 Modified outcome matrix reporting status categories for risk of selective reporting bias

Appendix S1 Descriptions of staged search strategy, study selection process and data extraction, and example of search strategy

Appendix S2 Included studies

Appendix S3 All outcome domains across all included studies

Table 1. Study characteristics

Study characteristic	n/N (%)
Type of study	
• Randomised controlled trial	99/160 (62%)
• Quasi-randomised controlled trial	11/160 (6.9%)
• Prospective cohort study	24/160 (15%)
• Prospective case series	21/160 (13%)
• Randomised pilot/feasibility study	5/160 (3.1%)
Geographic distribution of recruitment	
(number of participants recruited by region also provided below)	
• Africa – 309 participants	4/160 (2.5%)
• Asia – 6043 participants	56/160 (35%)
• Australasia – 2271 participants	7/160 (4.4%)
• Europe – 8192 participants	65/160 (41%)
• North America – 2997 participants	22/160 (14%)
• South America – 416 participants	6/160 (3.8%)
Number of sites	
• Single-centre	136/160 (85%)
• Multi-centre	24/160 (15%)
Number of participants in randomised/quasi-randomised studies	
• ≤50	49/110 (45%)
• 51-100	41/110 (37%)
• >100	20/110 (18%)

n – number of studies within each category of a characteristic

N – total number of studies for which data were available for the characteristic

404

405 **Table 2.** Time points of verbatim outcomes

Time point range	n/N (%) 406
Baseline (pre-intervention)	326/3936 (8.3%)
Immediately post-intervention to 14 days	573/3936 (15%)
>14 days to 6 weeks	823/3936 (21%)
>6 weeks to 6 months	1109/3936 (28%)
>6 months to 1 year	742/3936 (19%)
>1 year	243/3936 (6.2%)
Final discharge/follow-up	88/3936 (2.2%)
Not stated	32/3936 (0.8%)

Table 3. Participant age and sex distribution in DRF and non-DRF studies

Type of study	Number of studies	Age distribution of participants			Sex distribution of participants		
		No. of studies reporting data	Range of mean age (years)	Weighted mean age (SD) (years)	No. of studies reporting data	Range (% female)	Weighted mean (SD) (% female)
DRF	121/160	113	32.2 – 77.1	58.2 (SD 10.4)	112	12.0 – 100.0	72 (SD 19)
Non-DRF	39/160	33	26.0 – 50.0	38.5 (SD 6.0)	38	0.0 – 59.0	33 (SD 18)

Weighted values in this table are mean and (SD)

n – number of verbatim outcomes within a given time point range

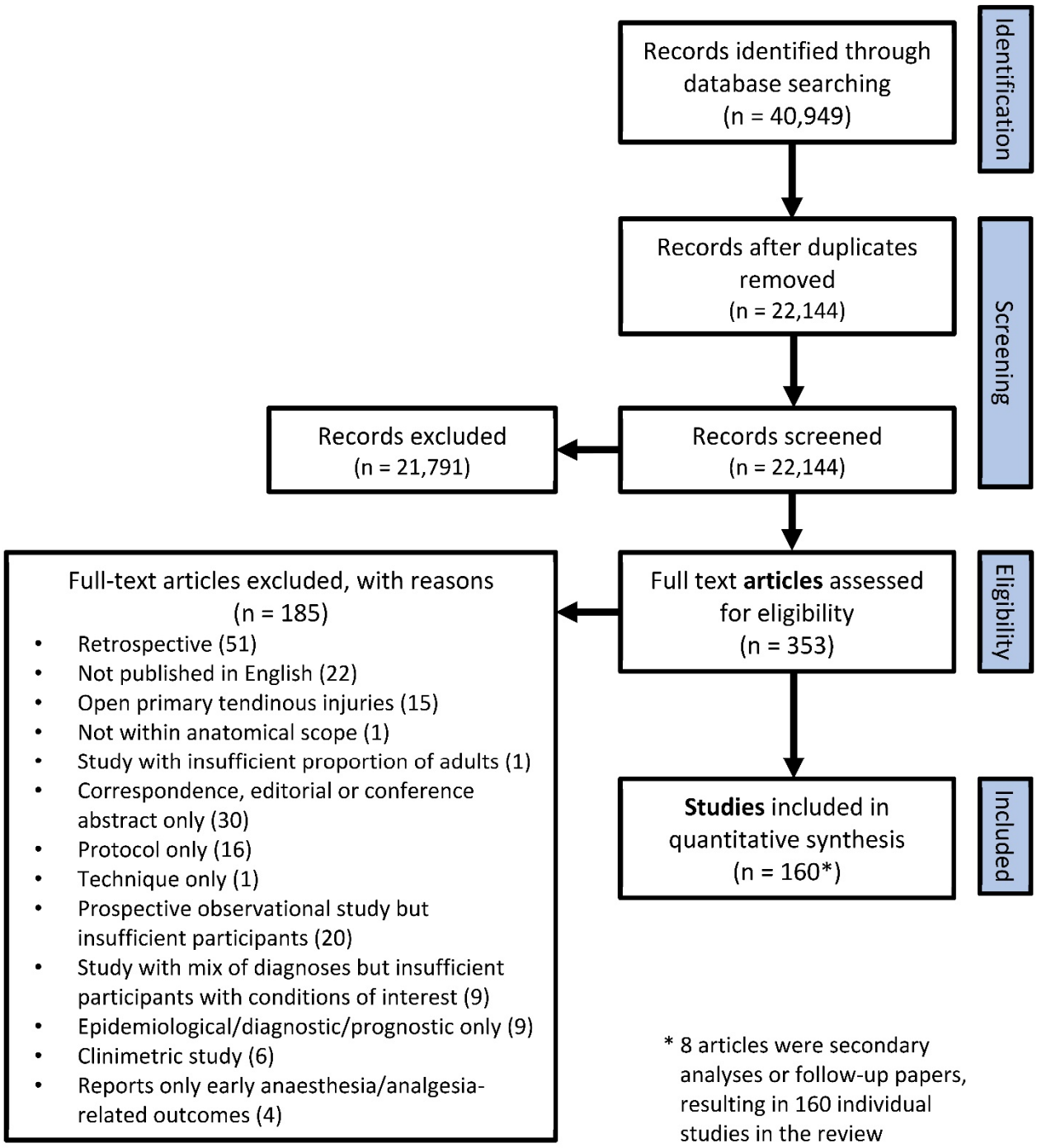
N – total number of different verbatim outcomes when accounting for time point at which outcome was assessed/measured

Table 4. Top five PROMs and ten outcome domains most commonly used across all studies and in DRF vs non-DRF studies

	Type of study		
	All studies (160 studies)	DRF study (121 studies)	Non-DRF study (39 studies)
PROM			
VAS pain	66/160 (41%)	51/121 (42%)	15/39(38%)
DASH	57/160 (36%)	46/121 (38%)	11/39 (28%)
PRWE	30/160 (19%)	28/121 (23%)	2/39 (5.1%)
QuickDASH	29/160 (18%)	17/121 (14%)	12/39 (31%)
EQ-5D-3L	13/160 (8.1%)	9/121 (7.4%)	4/39 (10%)
Outcome domain			
b280 Sensation of pain	147/160 (92%)	108/121 (89%)	39/39 (100%)
b710 Mobility of joint functions	137/160 (86%)	102/121 (84%)	35/39 (90%)
b730 Muscle power functions	123/160 (77%)	94/121 (78%)	29/39 (74%)
d850 Remunerative employment	115/160 (72%)	84/121 (69%)	31/39 (79%)
d440 Fine hand use	114/160 (71%)	85/121 (70%)	29/39 (74%)
d920 Recreation and leisure	113/160 (71%)	84/121 (69%)	29/39 (74%)
d510 Washing oneself	111/160 (69%)	83/121 (69%)	28/39 (72%)
d430 Lifting and carrying objects	111/160 (69%)	82/121 (68%)	29/39 (74%)
d640 Doing housework	110/160 (69%)	82/121 (68%)	28/39 (72%)
d445 Hand and arm use	107/160 (67%)	81/121 (67%)	26/39 (67%)

VAS: visual analogue scale; DASH: disability of the arm, shoulder and hand; PRWE: patient-rated wrist evaluation; QuickDASH: abbreviated version of DASH; EQ-5D-3L: EuroQOL-5D-3L tool

Figure 1 PRISMA Flow Diagram



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422 **Figure 2** Pie chart demonstrating number and proportion of outcomes by assessor category

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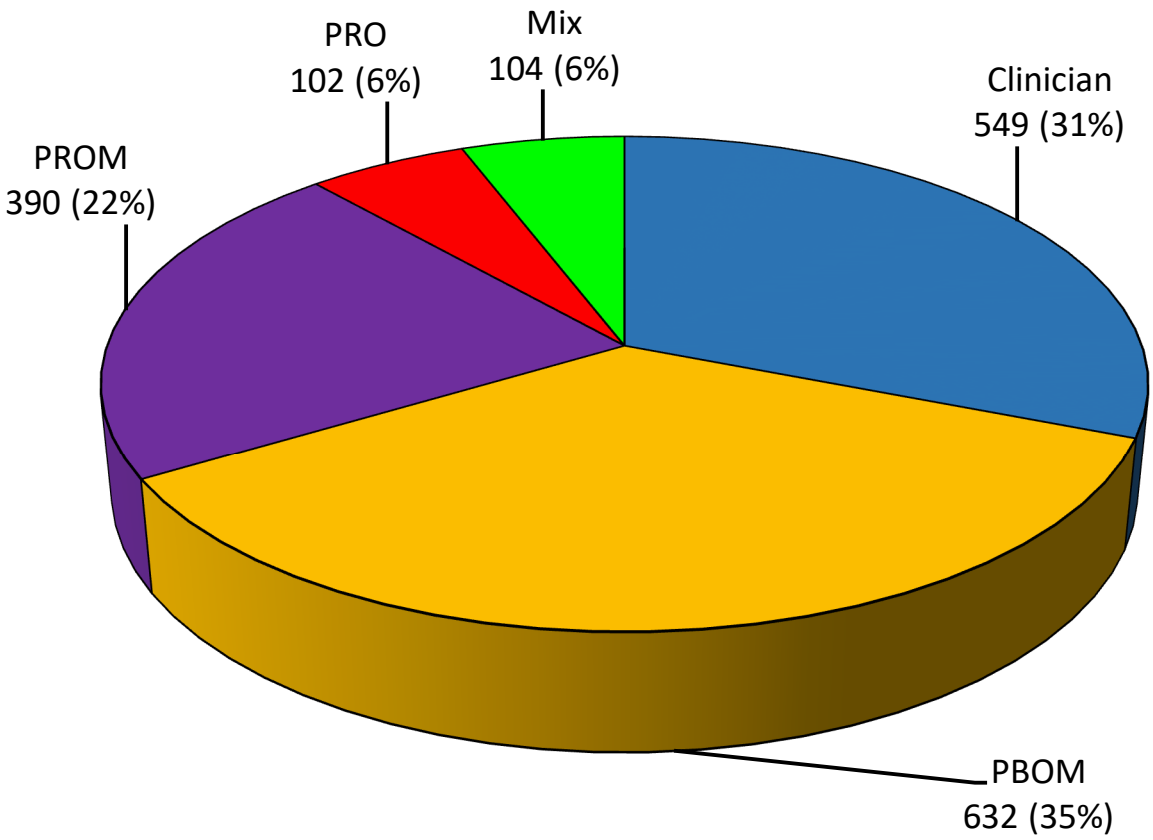

PROM – patient-reported outcome measure; PRO – patient-reported outcome;

PBOM – performance-based outcome measure

Figure 3 Cumulative bar chart showing percentage and number of outcomes within each reporting bias category across study types

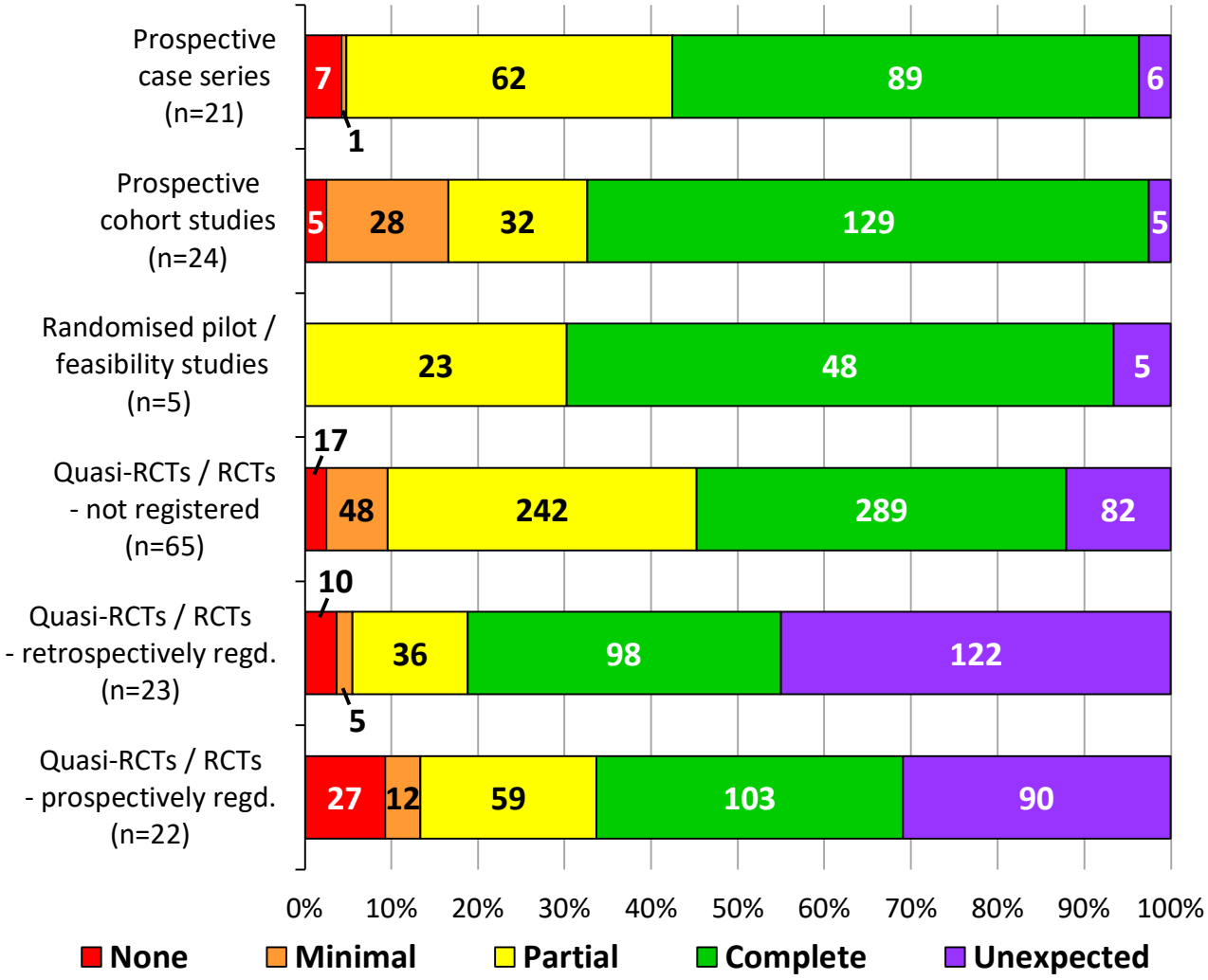

Table S1. Inclusion and exclusion criteria for studies

Criteria
Inclusion criteria
Study design
• Randomised/Quasi-randomised controlled trials or pilot studies
• Prospective observational studies (cohort/case series) with ≥100 patients enrolled
Population
• Adults who sustained an injury within the scope of the review
• Studies of mixed populations (e.g. adults and children) have been included if ≥90% of the population were adults
Intervention
• Any interventions for the treatment of hand fractures and joint injuries, whether conservative or surgical, but not prophylactic or preventative interventions
Exclusion criteria
• Systematic reviews
• Biomechanical studies
• Cadaveric studies
• Reports where only abstract (rather than full report) available (incl. conference abstracts)
• Unpublished and ongoing studies
• Studies not assessing treatments (e.g. purely diagnostic/epidemiological studies)
• Purely clinimetric studies (studies only evaluating/validating measurement instruments)
• Studies which only reported early anaesthesia/analgesia-related outcomes (i.e. within first 24 hours of intervention)

Table S2. Modified outcome matrix reporting status categories for risk of selective reporting bias

Category	Definition
Not done	No clear reporting of an outcome either through description, a table or figure
Minimal	Outcome reported merely by a summary comment (e.g. 'there was no significant difference between the intervention arms') but with no numerical values provided, or if there is such deficiency of information that the reporting is no longer meaningful (e.g. values given but no indication of time point)
Partial	Outcome reported but not at all time points specified elsewhere in the study/registration or lacks sufficient detail to be included in a meta-analysis (e.g. mean value is reported but not variance or p-value for the difference in means between intervention arms)
Complete	Outcome reported at all time points specified elsewhere in the study and with sufficient detail to allow inclusion in a meta-analysis
Unexpected	Outcome reported but was not specified in the study registration or prior to the 'Results' section of the study

Appendix S1 Descriptions of staged search strategy, study selection process and data extraction, and example of search strategy

Staged search strategy

The staged search strategy involved an initial search run on 29/03/2019. Data extraction and analysis were conducted for studies published in the last five years (01/01/2014 to 29/03/2019). Outcomes extracted from studies published in 2014 were compared to those extracted from studies published from 2015 onwards. If novel important outcomes were identified from studies published in 2014, then the search would have been extended back by a further year, i.e. 2013. If necessary, this process would be repeated until either 'outcome saturation' was reached or the search was extended to a maximum of ten years.

Study selection process

We checked titles and abstracts of retrieved articles and removed duplicates using a combination of the deduplication tool and manual checking. Two reviewers (SRD and DG) independently screened deduplicated titles and abstracts for eligibility based on the criteria in Table 1, with any disagreements resolved by discussion and senior author input (AK). For those that passed this sifting process, we then screened the full-text articles for inclusion. In the case of an article being a follow-up or secondary analysis of a study, the original study report or primary analysis was located and included.

Data extraction

A single reviewer (SRD) extracted the following data: author details, lead country where study was conducted, single- or multi-centre, publication year and journal, whether time points for outcome collection were from injury/randomisation/intervention, study type and registration status (if RCT/qRCT). If registration was not indicated in the publication, we searched for the study in the World Health Organization International Clinical Trials Registry Platform (World Health Organization, 2020). If no registration was found, we contacted the study's corresponding author. We took non-response to mean that no trial registration was completed.

We performed independent two-reviewer extraction of all other data (SRD for all studies; second data extraction divided between CM and BM), with disagreement resolved through discussion.

Example search strategy

An example search strategy is provided for Ovid MEDLINE. The other databases searched were PubMed, Ovid Embase, Cochrane Central Register of Controlled Trials (CENTRAL), CINAHL (EBSCO), PEDro and Ovid PsycINFO.

OVID MEDLINE

1. exp Hand/
2. hand.ti.
3. hands.mp.
4. exp Hand Bones/
5. phalan*.mp.
6. finger.mp.
7. fingers.mp.
8. thumb.mp.
9. thumbs.mp.
10. metacarp*.mp.
11. wrist.mp.
12. wrists.mp.
13. carpus.mp.
14. carpi.mp.
15. carpal.mp.
16. carpals.mp.
17. scapho*.mp.
18. hamate.mp.
19. hamates.mp.
20. lunate.mp.
21. lunates.mp.
22. triquet*.mp.
23. trapeziu*.mp.
24. trapezoi*.mp.
25. pisiform.mp.
26. pisiforms.mp.
27. exp Radius/ and distal.mp
28. distal radio*.mp.
29. distal radius.mp.
30. distal radial.mp.
31. radial styloid*.mp.
32. exp Collateral Ligament, Ulnar/
33. radial collateral.mp.
34. rcl.mp.
35. ulnar collateral.mp.

36. ucl.mp.
37. sagittal band.mp.
38. sagittal bands.mp.
39. beak ligament.mp.
40. beak ligaments.mp.
41. exp Palmar Plate/
42. volar plate.mp.
43. volar plates.mp.
44. exp Triangular Fibrocartilage/
45. triangular fibrocartilage.mp.
46. triangular fibrocartilages.mp.
47. triangular cartilage.mp.
48. triangular cartilages.mp.
49. triangular fibrocartilaginous.mp.
50. triangular ligament.mp.
51. triangular ligaments.mp.
52. tfcc.mp.
53. exp Hand Joints/
54. interphalangeal.mp.
55. metacarpophalangeal.mp.
56. carpometacarpal.mp.
57. druj.mp.
58. pericapitate.mp.
59. transcapitate.mp.
60. midcarpal.mp.
61. mesocarpal.mp.
62. mediocarpal.mp.
63. carpocarpal.mp.
64. transcarpal.mp.
65. intracarpal.mp.
66. perihamate.mp.
67. transhamate.mp.
68. hemihamate.mp.
69. perilunate.mp.
70. perilunar.mp.
71. translunate.mp.
72. midmetacarpal.mp.
73. transmetacarpal.mp.
74. midphalangeal.mp.
75. transphalangeal.mp.
76. peripisiform.mp.
77. periscaphoid.mp.

78. transscaphoid.mp.
79. peritrapezium.mp.
80. peritrapezial.mp.
81. transtrapezium.mp.
82. transtrapezial.mp.
83. pantrapezial.mp.
84. peritrapezoid.mp.
85. peritrapezoidal.mp.
86. peritriquetral.mp.
87. transtriquetrum.mp.
88. transtriquetral.mp.
89. cleland's ligament.mp.
90. cleland's ligaments.mp.
91. grayson's ligament.mp.
92. grayson's ligaments.mp.
93. extensor retinaculum.mp.
94. lateral band.mp.
95. lateral bands.mp.
96. lunotriquetral.mp.
97. natatory ligament.mp.
98. natatory ligaments.mp.
99. pisohamate.mp.
100. pisometacarpal.mp.
101. radiocapitate.mp.
102. radiolunotriquetral.mp.
103. radiopalmar.mp.
104. radioscaphocapitate.mp.
105. radioscapholunate.mp.
106. radiotriquetral.mp.
107. retinacular ligament.mp.
108. retinacular ligaments.mp.
109. scaphotrapeziotrapezoid.mp.
110. scaphotrapezoid.mp.
111. flexor pulley.mp.
112. flexor pulleys.mp.
113. annular pulley.mp.
114. annular pulleys.mp.
115. oblique pulley.mp.
116. oblique pulleys.mp.
117. trapeziocapitate.mp.
118. trapeziotrapezoid.mp.
119. triquetralcapitate.mp.

120. triquetralhamate.mp.
121. triquetrocapitate.mp.
122. triquetrohamate.mp.
123. ulnocapitate.mp.
124. ulnolunate.mp.
125. ulnotriquetral.mp.
126. (abductor digiti or abductor pollicis or adductor pollicis or anconeus or brachialis or brachioradialis or extensor carpi or extensor digiti or extensor digitorum or extensor indicis or extensor pollicis or flexor carpi or flexor digiti minimi or flexor digitorum or flexor pollicis or hypothenar or hypothenars or interosseous or interosseus or interossei or lumbrical or lumbricals or opponens digiti minimi or opponens pollicis or palmaris brevis or palmaris longus or pronator quadratus or pronator teres or supinator or supinators or thenar or thenars or parona or APL or ECRB or ECRL or ECU or ED or EDC or EDM or EIP or EPB or EPL or FCR or FCU or FDP or FDS or FPL or hand or wrist or finger or thumb).mp. and ((tendon or tendons).mp. or exp Tendons/)
127. central slip.mp.
128. central slips.mp.
129. extensor expansion.mp.
130. extensor expansions.mp.
131. extensor hood.mp.
132. extensor hoods.mp.
133. junctura tendinum.mp.
134. juncturae tendinum.mp.
135. palmaris brevis.mp.
136. palmaris longus.mp.
137. fractures, bone/ or exp fracture dislocation/ or exp fractures, avulsion/ or exp fractures, closed/ or exp fractures, comminuted/ or exp fractures, compression/ or exp fractures, malunited/ or exp fractures, multiple/ or exp fractures, open/ or exp fractures, spontaneous/ or exp fractures, stress/ or exp intra-articular fractures/ or exp osteoporotic fractures/
138. Joint Instability/
139. Joint Dislocation/
140. Sprains and Strains/
141. exp Tendon Injuries/
142. injuries.fs
143. fractur*.mp.
144. trauma.mp.
145. non-union.mp.
146. nonunion.mp.
147. avulsio*.mp.
148. tear*.mp.
149. torn*.mp.

150. rupture*.mp.
151. sprain*.mp.
152. instability*.mp.
153. dislocation*.mp.
154. dislocated.mp.
155. subluxation*.mp.
156. subluxed.mp.
157. mallet*.mp.
158. exp Hand Injuries/
159. Forearm Injuries/ or exp Radius Fractures/
160. exp Wrist Injuries/
161. boutonnier*.mp.
162. colles*.ti,ab,kw and fracture*.mp.
163. smith*.ti,ab,kw and fracture*.mp.
164. bennett*.ti,ab,kw and fracture*.mp.
165. rolando*.ti,ab,kw and fracture*.mp.
166. barton*.ti,ab,kw and fracture*.mp.
167. ((jersey or rugby or sweater) and (finger* or fracture* or avulsion* or rupture* or tear*)).mp.
168. (boxer* and (fracture* or finger or fingers or knuckle*)).mp.
169. (gamekeeper* and (fracture* or avulsion* or rupture* or tear* or thumb or thumbs)).mp.
170. (skier* and (fracture* or avulsion* or rupture* or tear* or thumb or thumbs)).mp
171. stener.mp.
172. die-punch.mp.
173. or/1-136
174. or/137-157
175. or/158-172
176. 173 and 174
177. 175 or 176
178. 177 not ((Infant/ or Preschool/ or exp Child/ or Adolescent/) not exp Adult/)
179. 178 not review.pt
180. limit 181 to yr="2014 -Current"

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First author	Study title	Year of publication	Diagnosis under study
Abe, Y.	Management of Intra-Articular Distal Radius Fractures: Volar or Dorsal Locking Plate-Which Has Fewer Complications?	2017	Distal radius fracture
Abimanyi-Ochom, J.	Changes in quality of life associated with fragility fractures: Australian arm of the International Cost and Utility Related to Osteoporotic Fractures Study (AusICUROS)	2015	Mix of wrist fracture - mainly distal radius
Abubeih, H. M. A.	Extensor tendon splitting versus extensor tendon sparing approach for miniplate fixation of extraarticular proximal phalangeal fractures	2016	Proximal phalanx fracture
Acosta-Olivo, C.	Laser Treatment on Acupuncture Points Improves Pain and Wrist Functionality in Patients Undergoing Rehabilitation Therapy after Wrist Bone Fracture. A Randomized, Controlled, Blinded Study	2017	Distal radius fracture
Aita, M. A.	Randomized clinical trial on percutaneous minimally invasive osteosynthesis of fractures of the distal extremity of the radius	2014	Distal radius fracture
Alkner, B. A.	Effect of postoperative pneumatic compression after volar plate fixation of distal radial fractures: a randomized controlled trial	2018	Distal radius fracture

Alsubheen, S. A.	The effect of diabetes on functional outcomes among individuals with distal radial fractures	2018	Distal radius fracture
Alter, T. H.	A Prospective Randomized Study Comparing Bupivacaine Hydrochloride Versus Bupivacaine Liposome for Pain Management After Distal Radius Fracture Repair Surgery	2017	Distal radius fracture
Andrade-Silva, F. B.	Influence of postoperative immobilization on pain control of patients with distal radius fracture treated with volar locked plating: A prospective, randomized clinical trial	2019	Distal radius fracture
Athar, S. M.	Is external fixation a better way than plaster to supplement K-wires in non-comminuted distal radius fractures?	2018	Distal radius fracture
Bartl, C.	The treatment of displaced intra-articular distal radius fractures in elderly patients	2014	Distal radius fracture
Batibay, S. G.	Conservative management equally effective to new suture anchor technique for acute mallet finger deformity: A prospective randomized clinical trial	2018	Mallet finger
Bayon-Calatayud, M.	Mirror therapy for distal radial fractures: A pilot randomized controlled study	2016	Distal radius fracture
Bentohami, A.	Non- or Minimally Displaced Distal Radial Fractures in Adult Patients: Three Weeks versus Five Weeks of Cast Immobilization-A Randomized Controlled Trial	2019	Distal radius fracture

Brehmer, J. L.	Accelerated rehabilitation compared with a standard protocol after distal radial fractures treated with volar open reduction and internal fixation: a prospective, randomized, controlled study	2014	Distal radius fracture
Brogren, E.	Cast-treated distal radius fractures: a prospective cohort study of radiological outcomes and their association with impaired calcaneal bone mineral density	2015	Distal radius fracture
Bruder, A. M.	A progressive exercise and structured advice program does not improve activity more than structured advice alone following a distal radial fracture: a multi-centre, randomised trial	2016	Distal radius fracture
Buijze, G. A.	Cast immobilization with and without immobilization of the thumb for nondisplaced and minimally displaced scaphoid waist fractures: a multicenter, randomized, controlled trial	2014	Scaphoid fracture
Cacchio, A.	Effectiveness and safety of a mixture of diosmin, coumarin and arbutin (Linfadren) in addition to conventional treatment in the management of patients with post-trauma/surgery persistent hand edema: a randomized controlled trial	2019	Mix of diagnoses. Over 80% distal radius/ulna fracture/scaphoid fracture

Cantero-Tellez, R.	Treatment of proximal interphalangeal joint flexion contracture: combined static and dynamic orthotic intervention compared with other therapy intervention: a randomized controlled trial	2015	PIPJ contracture
Cantlon, Matthew B.	Does malunion in multiple planes predict worse functional outcomes in distal radial fractures?	2016	Distal radius fracture
Caporrino, F. A.	Dorsal vascularized grafting for scaphoid nonunion: a comparison of two surgical techniques	2014	Scaphoid nonunion
Cepni, S. K.	A minimally invasive fixation technique for selected patients with fifth metacarpal neck fracture	2016	Little finger metacarpal neck fracture
Chang, W. D.	Therapeutic outcomes of low-level laser therapy for closed bone fracture in the human wrist and hand	2014	Mix
Che Daud, A. Z.	Integration of occupation based intervention in hand injury rehabilitation: A Randomized Controlled Trial	2016	Mix
Chen, C.	The efficacy of using 3D printing models in the treatment of fractures: a randomised clinical trial	2019	Distal radius fracture

Christersson, A.	Prospective randomized feasibility trial to assess the use of rhPDGF-BB in treatment of distal radius fractures	2015	Distal radius fracture
Christersson, A.*	Radiographic results after plaster cast fixation for 10 days versus 1 month in reduced distal radius fractures: a prospective randomised study	2016	Distal radius fracture
Chung, K. C.**	Assessment of Distal Radius Fracture Complications Among Adults 60 Years or Older: A Secondary Analysis of the WRIST Randomized Clinical Trial	2019	Distal radius fracture
Clementson, M.*	Conservative Treatment Versus Arthroscopic-Assisted Screw Fixation of Scaphoid Waist Fractures – A Randomized Trial With Minimum 4-Year Follow-Up	2015	Scaphoid fracture
Constand, M. K.	Patient-centered care and distal radius fracture outcomes: a prospective cohort study analysis	2014	Distal radius fracture
Costa, M. L.*	UK DRAFFT: a randomised controlled trial of percutaneous fixation with Kirschner wires versus volar locking-plate fixation in the treatment of adult patients with a dorsally displaced fracture of the distal radius	2015	Distal radius fracture
Daddamani, Ravi M.	A Study of Unstable Distal Radius Fractures Treated by Percutaneous Techniques	2014	Distal radius fracture
Dailey, S. K.	The Effectiveness of Mini-C-Arm Fluoroscopy for the Closed Reduction of Distal Radius Fractures in Adults: A Randomized Controlled Trial	2018	Distal radius fracture

Daniel, R.	The effect of local bone mineral density on the rate of mechanical failure after surgical treatment of distal radius fractures: a prospective multicentre cohort study including 249 patients	2015	Distal radius fracture
Dennison, D. G.	Early Versus Late Motion Following Volar Plating of Distal Radius Fractures	2018	Distal radius fracture
Dilek, B.	Effectiveness of the graded motor imagery to improve hand function in patients with distal radius fracture: A randomized controlled trial	2018	Distal radius fracture
Drac, P.	Comparison of the results and complications of palmar and dorsal mini-invasive approaches in the surgery of scaphoid fractures. A prospective randomized study	2014	Scaphoid fracture
Drobetz, H.	Volar locking distal radius plates show better short-term results than other treatment options: A prospective randomised controlled trial	2016	Distal radius fracture
Duckworth, A. D.	Effect of Alendronic Acid on Fracture Healing: A Multicenter Randomized Placebo-Controlled Trial	2019	Distal radius fracture
Ekrol, I.	The influence of vitamin C on the outcome of distal radial fractures: a double-blind, randomized controlled trial	2014	Distal radius fracture
El-Hadidy, S. S.	Occupational and non occupational metacarpal bone fractures at the Mansoura University Emergency Hospital: A comparative study	2019	Metacarpal fracture

El-Saeed, M.	Kirschner Wires Versus Titanium Plates and Screws in Management of Unstable Phalangeal Fractures: A Randomized, Controlled Clinical Trial	2019	Proximal and middle phalanx fractures
Fakoor, M.	Displaced Intra-Articular Fractures of the Distal Radius: Open Reduction With Internal Fixation Versus Bridging External Fixation	2015	Distal radius fracture
Filipova, V.	Efficacy of combined physical and occupational therapy in patients with conservatively treated distal radius fracture: randomized controlled trial	2015	Distal radius fracture
Finger, A.	Do patients prefer optional follow-up for simple upper extremity fractures: A pilot study	2016	Mix
Galal, S.	Transverse pinning versus intramedullary pinning in fifth metacarpal's neck fractures: A randomized controlled study with patient-reported outcome	2017	Little finger metacarpal neck fracture
Galos, D. K.	Does Brachial Plexus Blockade Result in Improved Pain Scores After Distal Radius Fracture Fixation? A Randomized Trial	2016	Distal radius fracture
Gamba, C.	Which immobilization is better for distal radius fracture? A prospective randomized trial	2017	Distal radius fracture

Gao, Y.	Timing for Surgical Stabilization with K-wires after Open Fractures of Proximal and Middle Phalangeal Shaft	2017	Open fracture proximal or middle phalanx shaft
Goehre, F.	Comparison of palmar fixed-angle plate fixation with K-wire fixation of distal radius fractures (AO A2, A3, C1) in elderly patients	2014	Distal radius fracture
Goudie, S.	Is Use of a Psychological Workbook Associated With Improved Disabilities of the Arm, Shoulder and Hand Scores in Patients With Distal Radius Fracture?	2018	Distal radius fracture
Gradl, G.	Intramedullary nail versus volar plate fixation of extra-articular distal radius fractures. Two year results of a prospective randomized trial	2014	Distal radius fracture
Gradl, G.	Fixation of intra-articular fractures of the distal radius using intramedullary nailing: a randomized trial versus palmar locking plates	2016	Distal radius fracture
Grle, M.	Early results of the conservative treatment of distal radius fractures-immobilization of the wrist in dorsal versus palmar flexion	2017	Distal radius fracture
Gruber, J. S.	A prospective randomized controlled trial comparing night splinting with no splinting after treatment of mallet finger	2014	Mallet finger

Gulke, J.	Postoperative treatment of metacarpal fractures-Classical physical therapy compared with a home exercise program	2018	Metacarpal fracture
Gutierrez-Espinoza, H.	Supervised physical therapy vs home exercise program for patients with distal radius fracture: A single-blind randomized clinical study	2017	Distal radius fracture
Gutierrez-Monclus, R.	Correlation Between Radiological Parameters and Functional Outcomes in Patients Older Than 60 Years of Age With Distal Radius Fracture	2018	Distal radius fracture
Haberle, S.	Pronator quadratus repair after volar plating of distal radius fractures or not? Results of a prospective randomized trial	2015	Distal radius fracture
Hammer, O. L.	Volar Locking Plates Versus Augmented External Fixation of Intra-Articular Distal Radial Fractures: Functional Results from a Randomized Controlled Trial	2019	Distal radius fracture
Hannemann, P. F.*	CT scan-evaluated outcome of pulsed electromagnetic fields in the treatment of acute scaphoid fractures: a randomised, multicentre, double-blind, placebo-controlled trial	2014	Scaphoid fracture
Hill, J. R.	Immobilization following Distal Radius Fractures: A Randomized Clinical Trial	2018	Distal radius fracture
Hohendorff, B.	Pronator quadratus repair with a part of the brachioradialis muscle insertion in volar plate fixation of distal radius fractures: a prospective randomised trial	2018	Distal radius fracture

Holmberg, A.	Pre-operative brachial plexus block compared with an identical block performed at the end of surgery: a prospective, double-blind, randomised clinical trial	2017	Distal radius fracture
Imai, R.	Influence of illusory kinesthesia by vibratory tendon stimulation on acute pain after surgery for distal radius fractures: a quasi-randomized controlled study	2016	Distal radius fracture
Imai, R.	Effect of illusory kinesthesia on hand function in patients with distal radius fractures: a quasi-randomized controlled study	2017	Distal radius fracture
Jesswani, M. L.	The Complex regional pain syndrome after fractures of distal radius	2014	Distal radius fracture
Kamal, Y.	Functional outcome of distal radius fractures managed by barzullah working classification	2015	Distal radius fracture
Kappos, E. A.	Implantation of a denaturated cellulose adhesion barrier after plate osteosynthesis of finger proximal phalangeal fractures: results of a randomized controlled trial	2016	Proximal phalanx fracture
Karantana, A.***	Cost-effectiveness of volar locking plate versus percutaneous fixation for distal radial fractures: Economic evaluation alongside a randomised clinical trial	2015	Distal radius fracture
Karponis, A.	Analgesic effect of nasal salmon calcitonin during the early post-fracture period of the distal radius fracture	2015	Distal radius fracture

Kato, S.	The results of volar locking plate fixation for the fragility fracture population with distal radius fracture in Japanese women	2014	Distal radius fracture
Khan, J. I.	A comparative study of functional outcome of treatment of intra articular fractures of distal radius fixed with percutaneous Kirschner's wires vs T-plate	2017	Distal radius fracture
Kim, J. K.	Antegrade intramedullary pinning versus retrograde intramedullary pinning for displaced fifth metacarpal neck fractures	2015	Little finger metacarpal neck fracture
Kim, J. K.	Natural history and factors associated with ulnar-sided wrist pain in distal radial fractures treated by plate fixation	2016	Distal radius fracture
Kumar, K.	Fracture of distal radius treated by orthofix v/s plaster cast	2014	Distal radius fracture
Kumar, S.	Comparison of treatment of unstable intra articular fractures of distal radius with locking plate versus non-locking plate fixation	2014	Distal radius fracture
Kumaravel, S.	Clinical and radiological comparison of displaced extra articular distal radius fracture treated with plaster or external fixator	2015	Distal radius fracture
Lalone, E. A.	A cohort study of one-year functional and radiographic outcomes following intra-articular distal radius fractures	2014	Distal radius fracture

Landgren, M.	Fragment-Specific Fixation Versus Volar Locking Plates in Primarily Nonreducible or Secondarily Redisplaced Distal Radius Fractures: A Randomized Controlled Study	2017	Distal radius fracture
Landgren, M.	Intermediate-Term Outcome After Distal Radius Fracture in Patients With Poor Outcome at 1 Year: A Register Study With a 2- to 12-Year Follow-Up	2019	Distal radius fracture
Larouche, J.	Determinants of Functional Outcome in Distal Radius Fractures in High-Functioning Patients Older Than 55 Years	2016	Distal radius fracture
Lee, C. H.	Single-Blinded, Randomized Preliminary Study Evaluating the Effect of Transcutaneous Electrical Nerve Stimulation on Postoperative Pain in Patients with Colles' Fracture	2015	Distal radius fracture
Lee, S. K.	Conservative Treatment Is Sufficient for Acute Distal Radioulnar Joint Instability With Distal Radius Fracture	2016	Acute DRUJ instability with distal radius fracture. All had volar plate for the radius fracture
Lei, M.	The effect of probiotic treatment on elderly patients with distal radius fracture: a prospective double-blind, placebo-controlled randomised clinical trial	2016	Distal radius fracture

Li, Z.	Treatment of the distal fracture in radioulna based on the volar wrist dual channel approach and postoperative X-ray diagnosis	2015	Distal radius and ulna fracture
Liu, Y.	Ultrasound treatment for accelerating fracture healing of the distal radius. A control study	2014	Distal radius fracture
Luo, P.	Pain Management during Rehabilitation after Distal Radius Fracture Stabilized with Volar Locking Plate: A Prospective Cohort Study	2018	Distal radius fracture
Ma, C.	External fixation is more suitable for intra-articular fractures of the distal radius in elderly patients	2016	Distal radius fracture
Ma, T.	The role of brachioradialis release during AO type C distal radius fracture fixation	2017	Distal radius fracture
Malizos, K. N.	Management of scaphoid nonunions with vascularized bone grafts from the distal radius: mid- to long-term follow-up	2017	Scaphoid nonunion
Mardani-Kivi, M.	Comparison of hematoma block and wrist block in the treatment of fracture of neck of fifth metacarpus	2019	Little finger metacarpal neck fracture
Martinez-Mendez, D.	Intra-articular distal radius fractures in elderly patients: a randomized prospective study of casting versus volar plating	2018	Distal radius fracture

Mehmood, A.	A Randomized Study of Dynamic vs Static External Fixation of Distal Radial Fractures	2018	Distal radius fracture
Mellstrand Navarro, C.*	Volar Locking Plate or External Fixation With Optional Addition of K-Wires for Dorsally Displaced Distal Radius Fractures: A Randomized Controlled Study	2016	Distal radius fracture
Miller, L.	No difference between two types of exercise after proximal phalangeal fracture fixation: a randomised trial	2016	Proximal phalanx fracture
Miller-Shahabar, I.	Efficacy of Compression Gloves in the Rehabilitation of Distal Radius Fractures: Randomized Controlled Study	2018	Distal radius fracture
Moens, K.	Pronator sparing plate osteosynthesis in distal radius fractures: early functional outcome	2018	Distal radius fracture
Moineau, B.	Superimposed electrical stimulation improves mobility of pre-stiff thumbs after ulnar collateral ligament injury of the metacarpophalangeal joint: a randomized study	2014	Stiffness after surgery for thumb UCL rupture
Moseley, G. L.	Intense pain soon after wrist fracture strongly predicts who will develop complex regional pain syndrome: prospective cohort study	2014	Wrist fracture
Namazi, H.	Investigating the Effect of Intra-articular Platelet-Rich Plasma Injection on Union: Pain and Function Improvement in Patients with Scaphoid Fracture	2016	Scaphoid fracture

Namazi, H.	Investigating the effect of intra-articular PRP injection on pain and function improvement in patients with distal radius fracture	2016	Distal radius fracture
Neutel, N.	Prognostic factors for return to work and resumption of other daily activities after traumatic hand injury	2019	Mix of injuries
Pandey, R.	Hand function outcome in closed small bone fractures treated by open reduction and internal fixation by mini plate or closed crossed pinning: a randomized controlled trail	2019	Metacarpal / phalangeal / thumb shaft fracture
Park, M. J.	Is a short arm cast appropriate for stable distal radius fractures in patients older than 55 years? A randomized prospective multicentre study	2017	Distal radius fracture
Patwardhan, T. Y.	Efficacy of Superficial Heat Therapy as an Adjunct to Therapeutic Exercise Program in Rehabilitation of Patients with Conservatively Managed Distal End Radius Fractures	2015	Distal radius fracture
Pellatt, R.	Is Buddy Taping as Effective as Plaster Immobilization for Adults With an Uncomplicated Neck of Fifth Metacarpal Fracture? A Randomized Controlled Trial	2019	Little finger metacarpal neck fracture
Perugia, D.	Comparison between Carbon-Peek volar locking plates and titanium volar locking plates in the treatment of distal radius fractures	2017	Distal radius fracture

Plate, J. F.	Randomized comparison of volar locking plates and intramedullary nails for unstable distal radius fractures	2015	Distal radius fracture
Quadlbauer, S.	Early Rehabilitation of Distal Radius Fractures Stabilized by Volar Locking Plate: A Prospective Randomized Pilot Study	2017	Distal radius fracture
Ratajczak, K.	The Effect of Isometric Massage on Global Grip Strength after Conservative Treatment of Distal Radial Fractures. Pilot Study	2015	Distal radius fracture
Rocchi, L.	A modified spica-splint in postoperative early-motion management of skier's thumb lesion: a randomized clinical trial	2014	UCL thumb rupture
Rocchi, L.	Antegrade Percutaneous Intramedullary Fixation Technique for Metacarpal Fractures: Prospective Study on 150 Cases	2018	Metacarpal fracture
Roh, Y. H.	Factors associated with complex regional pain syndrome type I in patients with surgically treated distal radius fracture	2014	Distal radius fracture
Roh, Y. H.	Effect of anxiety and catastrophic pain ideation on early recovery after surgery for distal radius fractures	2014	Distal radius fracture
Roh, Y. H.	Factors delaying recovery after volar plate fixation of distal radius fractures	2014	Distal radius fracture

Roh, Y. H.	A randomized comparison of volar plate and external fixation for intra-articular distal radius fractures	2015	Distal radius fracture
Sabzghabaei, A.	Ultrasound-Guided Reduction of Distal Radius Fractures	2016	Distal radius fracture
Safdari, M.	Comparing the effect of volar plate fixators and external fixators on outcome of patients with intra-articular distal radius fractures: A clinical trial	2015	Distal radius fracture
Saied, A.	Prophylactic corticosteroid injection in ulnar wrist pain in distal radius fracture	2015	Distal radius fracture
Saito, K.	A randomized controlled trial of the effect of 2-step orthosis treatment for a mallet finger of tendinous origin	2016	Mallet finger
Sarmiento, A.	Colles' fractures: functional treatment in supination	2014	Distal radius fracture
Scaglione, M.	Strontium ranelate as an adjuvant for fracture healing: clinical, radiological, and ultrasound findings in a randomized controlled study on wrist fractures	2016	Distal radius fracture
Sen, R	Home-based Exercise Program(HEP) Vs. Institution-based Occupational Therapy(IOT) in improving hand skills in post Collies' fractures: A comparative study	2014	Distal radius fracture
Shakir, S.	Titanium versus Stainless-Steel Plating in the Surgical Treatment of Distal Radius Fractures: A Randomized Trial	2016	Distal radius fracture

Sharma, H.	Outcomes and complications of fractures of distal radius (AO type B and C): volar plating versus nonoperative treatment	2014	Distal radius fracture
Shewring, D. J.	Fractures at the junction of diaphysis and metaphysis of the proximal phalanges in adults	2018	Proximal phalanx fracture
Shukla, R.	External fixation versus volar locking plate for displaced intra-articular distal radius fractures: a prospective randomized comparative study of the functional outcomes	2014	Distal radius fracture
Shukla, R.	A Long-Term Study of Application of Joshi's External Stabilizing System in Displaced Intra-articular Distal End Radius Fractures	2019	Distal radius fracture
Sirnio, K.	Early palmar plate fixation of distal radius fractures may benefit patients aged 50 years or older: a randomized trial comparing 2 different treatment protocols	2019	Distal radius fracture
Sletten, I. N.	Conservative treatment has comparable outcome with bouquet pinning of little finger metacarpal neck fractures: a multicentre randomized controlled study of 85 patients	2015	Little finger metacarpal neck fracture
Socransky, S.	Ultrasound-Assisted Distal Radius Fracture Reduction	2016	Distal radius fracture
Strassmair, M. K.	Distal Radial Fracture Management With an Intramedullary Cage and Fragment Fixation	2016	Distal radius fracture

Stuby, F. M.	Early functional postoperative therapy of distal radius fracture with a dynamic orthosis: results of a prospective randomized cross-over comparative study	2015	Distal radius fracture
Szekeres, M.*	The Effect of Therapeutic Whirlpool and Hot Packs on Hand Volume During Rehabilitation After Distal Radius Fracture: A Blinded Randomized Controlled Trial	2017	Distal radius fracture
Tahririan, M. A.	Results of pronator quadratus repair in distal radius fractures to prevent tendon ruptures	2014	Distal radius fracture
Tanaka, H.	Comparative study of treatment for distal radius fractures with two different palmar locking plates	2016	Distal radius fracture
Teunis, T.	Catastrophic Thinking Is Associated With Finger Stiffness After Distal Radius Fracture Surgery	2015	Distal radius fracture
Valdes, K.	Therapist-supervised hand therapy versus home therapy with therapist instruction following distal radius fracture	2015	Distal radius fracture
van Aaken, J.	Fifth metacarpal neck fractures treated with soft wrap/buddy taping compared to reduction and casting: results of a prospective, multicenter, randomized trial	2016	Little finger metacarpal neck fracture

Venkatesh, R. B.	A Comparative Study between Closed Reduction and Cast Application Versus Percutaneous K- Wire Fixation for Extra-Articular Fracture Distal end of Radius	2016	Distal radius fracture
Vergara, I.	Wrist fractures and their impact in daily living functionality on elderly people: a prospective cohort study	2016	Distal radius fracture
Vernet, P.	Treatment of tendinous mallet fingers using a Stack splint versus a dorsal glued splint	2019	Mallet finger
Wadsten, M. A.*	Influence of Cortical Comminution and Intra-articular Involvement in Distal Radius Fractures on Clinical Outcome: A Prospective Multicenter Study	2014	Distal radius fracture
Wadsten, M. A.	Cortical comminution in distal radial fractures can predict the radiological outcome: a cohort multicentre study	2018	Distal radius fracture
Wang, Y.	Effect and nursing study of traditional Chinese medicine preparation huayu zhitong powder in the treatment of distal radius fracture	2015	Distal radius fracture
Watson, N.	A Comparison of the Effect of One, Three, or Six Weeks of Immobilization on Function and Pain After Open Reduction and Internal Fixation of Distal Radial Fractures in Adults: A Randomized Controlled Trial	2018	Distal radius fracture
Williksen, J. H.***	External Fixation and Adjuvant Pins Versus Volar Locking Plate Fixation in Unstable Distal Radius Fractures: A Randomized, Controlled Study With a 5-Year Follow-Up	2015	Distal radius fracture

Wollstein, R.	Postoperative Treatment of Distal Radius Fractures Using Sensorimotor Rehabilitation	2019	Distal radius fracture
Yamazaki, H.	Arthroscopic assistance does not improve the functional or radiographic outcome of unstable intra-articular distal radial fractures treated with a volar locking plate: a randomised controlled trial	2015	Distal radius fracture
Ydreborg, K.	Hand function, experienced pain, and disability after distal radius fracture	2015	Distal radius fracture
Yeoh, J. C.	Role of Depression in Outcomes of Low-Energy Distal Radius Fractures in Patients Older Than 55 Years	2016	Distal radius fracture
Zehir, S.	Intramedullary repair device against volar plating in the reconstruction of extra-articular and simple articular distal radius fractures; a randomized pilot study	2014	Distal radius fracture
Zhang, B.	Comparison of AO Titanium Locking Plate and Screw Fixation versus Anterograde Intramedullary Fixation for Isolated Unstable Metacarpal and Phalangeal Fractures	2016	Mix
Zhang, X.	A comparison of minimally invasive approach vs conventional approach for volar plating of distal radial fractures	2017	Distal radius fracture
Zhang, X.	A randomized comparison of bone-cement K-wire fixation vs. plate fixation of shaft fractures of proximal phalanges	2018	Proximal phalanx fracture

Zhu, H.	Three-screw versus two-screw fixation of distal fragment in fifth metacarpal neck fractures stabilized with locking plate	2017	Little finger metacarpal neck fracture
Zyluk, A.	Percutaneous K-wires vs palmar locking plate fixation for different types of distal radial fractures: a comparison of the outcomes of two methods to control our guidelines	2018	Distal radius fracture
Zyluk, A.	A comparison of outcomes of K-wire vs plate fixation for distal radial fractures with regard to patients' quality of life	2018	Distal radius fracture

663 * Also includes data from a follow-up study/secondary analysis

664 ** A secondary analysis published before the primary. Primary analysis published after completion of review, but all outcomes extracted from trial
665 registration and from secondary analysis

666 *** Also includes data from a primary study published prior to search window

Appendix S3 All outcome domains across all included studies

Outcome domain	Type of study		
	DRF study (n=121)	Non-DRF study (n=39)	All studies (n=160)
b280 Sensation of pain	108 (89%)	39 (100%)	147 (92%)
b710 Mobility of joint functions	102 (84%)	35 (90%)	137 (86%)
b730 Muscle power functions	94 (78%)	29 (74%)	123 (77%)
b265 Touch function	78 (64%)	25 (64%)	103 (64%)
b134 Sleep functions	69 (57%)	25 (64%)	94 (59%)
b126 Temperament and personality functions	59 (49%)	14 (36%)	73 (46%)
b640 Sexual functions	46 (38%)	11 (28%)	57 (36%)
b152 Emotional functions	33 (27%)	5 (13%)	38 (24%)
b180 Experience of self and time functions	15 (12%)	5 (13%)	20 (13%)
b130 Energy and drive functions	17 (14%)	1 (2.6%)	18 (11%)
b820 Repair functions of the skin	12 (9.9%)	1 (2.6%)	13 (8.1%)
b455 Exercise tolerance functions	10 (8.3%)	1 (2.6%)	11 (6.9%)
b289 Sensation of pain, other specified and unspecified	8 (6.6%)	1 (2.6%)	9 (5.6%)
b270 Sensory functions related to temperature and other stimuli	7 (5.8%)	1 (2.6%)	8 (5.0%)
b830 Other functions of the skin	7 (5.8%)	1 (2.6%)	8 (5.0%)
b164 Higher-level cognitive functions	7 (5.8%)	0 (0%)	7 (4.4%)
b760 Control of voluntary movement functions	5 (4.1%)	1 (2.6%)	6 (3.8%)
b140 Attention functions	3 (2.5%)	0 (0%)	3 (1.9%)
b160 Thought functions	3 (2.5%)	0 (0%)	3 (1.9%)
b715 Stability of joint functions	2 (1.7%)	1 (2.6%)	3 (1.9%)
b144 Memory functions	2 (1.7%)	0 (0%)	2 (1.3%)
b117 Intellectual functions	1 (0.8%)	0 (0%)	1 (0.6%)
b122 Global psychosocial functions	1 (0.8%)	0 (0%)	1 (0.6%)
b156 Perceptual functions	1 (0.8%)	0 (0%)	1 (0.6%)
b260 Proprioceptive function	1 (0.8%)	0 (0%)	1 (0.6%)

Outcome domain	Type of study		
	DRF study (n=121)	Non-DRF study (n=39)	All studies (n=160)
d850 Remunerative employment	84 (69%)	31 (80%)	115 (72%)
d440 Fine hand use	85 (70%)	29 (74%)	114 (71%)
d920 Recreation and leisure	84 (69%)	29 (74%)	113 (71%)
d510 Washing oneself	83 (69%)	28 (72%)	111 (69%)
d430 Lifting and carrying objects	82 (68%)	29 (74%)	111 (69%)
d640 Doing housework	82 (68%)	28 (72%)	110 (69%)
d445 Hand and arm use	81 (67%)	26 (67%)	107 (67%)
d550 Eating	79 (65%)	26 (67%)	105 (66%)
d230 Carrying out daily routine	73 (60%)	26 (67%)	99 (62%)
d540 Dressing	77 (64%)	18 (46%)	95 (59%)
d750 Informal social relationships	63 (52%)	21 (54%)	84 (53%)
d760 Family relationships	62 (51%)	21 (54%)	83 (52%)
d470 Using transportation	48 (40%)	11 (28%)	59 (37%)
d650 Caring for household objects	46 (38%)	11 (28%)	57 (36%)
d410 Changing basic body position	40 (33%)	4 (10%)	44 (28%)
d530 Toileting	35 (29%)	5 (13%)	40 (25%)
d450 Walking	21 (17%)	2 (5.1%)	23 (14%)
d455 Moving around	12 (9.9%)	1 (2.6%)	13 (8.1%)
d839 Education unspecified	7 (5.8%)	2 (5.1%)	9 (5.6%)
d520 Caring for body parts	7 (5.8%)	1 (2.6%)	8 (5.0%)
d630 Preparing meals	5 (4.1%)	3 (7.7%)	8 (5.0%)
d560 Drinking	4 (3.3%)	1 (2.6%)	5 (3.1%)
d620 Acquisition of goods and services	4 (3.3%)	1 (2.6%)	5 (3.1%)
d570 Looking after one's health	3 (2.5%)	0 (0%)	3 (1.9%)
d420 Transferring oneself	2 (1.7%)	1 (2.6%)	3 (1.9%)
d460 Moving around in different locations	2 (1.7%)	1 (2.6%)	3 (1.9%)
d855 Non-remunerative employment	2 (1.7%)	1 (2.6%)	3 (1.9%)
d870 Economic self-sufficiency	2 (1.7%)	1 (2.6%)	3 (1.9%)
d845 Acquiring, keeping and terminating a job	1 (0.8%)	2 (5.1%)	3 (1.9%)

d475 Driving	2 (1.7%)	0 (0%)	2 (1.3%)
d710 Basic interpersonal interactions	1 (0.8%)	0 (0%)	1 (0.6%)
d720 Complex interpersonal interactions	1 (0.8%)	0 (0%)	1 (0.6%)
d860 Basic economic transactions	1 (0.8%)	0 (0%)	1 (0.6%)
d910 Community life	1 (0.8%)	0 (0%)	1 (0.6%)

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Outcome domain	Type of study		
	DRF study (n=121)	Non-DRF study (n=39)	All studies (n=160)
e580 Health services, systems and policies	28 (23%)	8 (21%)	36 (23%)
e565 Economic services, systems and policies	1 (0.8%)	1 (2.6%)	2 (1.3%)

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Outcome domain	Type of study		
	DRF study (n=121)	Non-DRF study (n=39)	All studies (n=160)
s730 Structure of upper extremity	74 (61%)	18 (46%)	92 (58%)
s810 Structure of areas of skin	5 (4.1%)	1 (2.6%)	6 (3.8%)

Outcome domain (not definable [nd] or not covered [nc] within WHO ICF)	Type of study		
	DRF study (n=121)	Non-DRF study (n=39)	All studies (n=160)
nc-Complications/Adverse events	73 (60%)	20 (51%)	93 (58%)
nc-Overall satisfaction	27 (22%)	11 (28%)	38 (24%)
nc-Bone healing	20 (17%)	16 (41%)	36 (23%)
nd-gh (general health)	18 (15%)	3 (7.7%)	21 (13%)
nd-ph (physical health)	17 (14%)	1 (2.6%)	18 (11%)
nc-Bone healing time	7 (5.8%)	9 (23%)	16 (10%)
nc-Technical (related to intervention)	11 (9.1%)	1 (2.6%)	12 (7.5%)
nc-Satisfaction with intervention	2 (1.7%)	1 (2.6%)	3 (1.9%)
nc-Blood tests	1 (0.8%)	0 (0%)	1 (0.6%)
nc-Individualised rating scale	1 (0.8%)	0 (0%)	1 (0.6%)
nd-Patient adherence to treatment	0 (0%)	1 (2.6%)	1 (0.6%)