Bilaga 4 till rapport

Behandling av armfraktur hos äldre/
Treatment options of arm fractures in the elderly, rapport 262 (2017)

Bilaga 4 Studier som ligger till grund for resultat och slutsatser (RCT-studier)/Studies of low and moderate risk of bias used for results and conclusions in the present report

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First author Pub. Year Reference Country	Injury Design Aim Time to follow-up Performed (yrs)	Participants Women/men Age	Intervention Participants Drop-out rate Side effects	Comparison group Participants Drop-out rate Side effects	Outcome	Risk of bias Comments
Abbaszadegan et al 1990 [1] Sweden	**Injury** Distal radius fractures, Older Type 3 and 4 **Design** Prospective randomized study **Aim** To compare primary external fixation with plaster-cast treatment **Time to follow-up** 8, 12, 24 weeks and 1 year **Performed (yrs)** Not stated	**Participants** Inclusion: severely dorsally displaced distal radius fractures Exclusion: age >75, addicts, senile patients, neuromuscular disturbances and Warfarin treatment n=47 36 women and 11 men Mean age: 63 years old (22–73)	**External fixation** Closed reduction, bridging Hoffmann external fixator. Mean fixation time 31 days **Participants** n=23 **Drop-out rate** n=1 died **Side effects** n=3 pin-tract infection	**Plaster-cast** Closed reduction and below-the-elbow plaster cast for 4 weeks (mean 31 days) **Participants** n=24 **Drop-out rate** n=0 **Side effects** n=5 redislocated after 11 days – received secondary external fixation (cross over) – separate group at analysis	**Lidström functional grading** (1 year): 19/22 patients in the primary external-fixation group were excellent or good as compared with 12/19 in the plaster-cast group ($p<0.005$). 3/5 in the secondary external fixation group were rated excellent or good **Grip strength**: no differences between the groups **Complications** 3 minor complications in the External fixation group and no reported complications in the Plaster-cast group	Moderate
Agorastides et al 2007 [2] United Kingdom	**Injury** Neer's type 3- and 4-part proximal humerus fracture **Design** Randomized controlled study	**Participants** Inclusion: isolated non-pathological displaced 3- and 4-part fractures or articular fractures of the proximal humerus; less than 6 weeks old; indication for primary	**Early mobilization group (2 weeks)** The arm was kept in a sling in neutral rotation for the first 2 weeks, while only pendulum and elbow exercises were	**Late mobilization group (6 weeks)** The arm was kept in a sling in neutral rotation for 6 weeks, with only elbow exercises being allowed. From the 7th	**Oxford score (SD, range)** ***12 months*** Early mobilization: 65 (23, 17–100) Late mobilization: 71 (14, 31–96) p-value: 0.39 ***6 months*** Early mobilization: 59 (23, 17–100)	Low

	Aim To compare early and late after prosthesis fracture surgery **Time to follow-up** 6 and 12 months **Performed (yrs)** 2002–2003	hemiarthroplasty; physiologically old patients with poor bone quality n=49 (59 were randomized) Early mobilization: 21 women and 5 men Late mobilization: 18 women and 5 men Mean age: 72 years for Early mobilization and 67 years for Late mobilization	allowed. Between the 3ed and the 6th week, the patients progressed to active-assisted exercises and from the 7th week, to active exercise **Participants** n=26 **Drop-out rate** Not reported **Side effects** 3 greater tuberosity migration, 6 superior subluxation and 1 dislocation	to the twelfth week, the patient progressed from pendulum to active-assisted exercised and, from the 13th week, to active exercise **Participants** n=23 **Drop-out rate** Not reported **Side effects** 1 greater tuberosity migration, 4 superior subluxation, 2 fracture dislocation and 1 head-splitting fracture	Late mobilization: 63 (18, 17–92) p-value: 0.45 **Constant shoulder score (SD, range)** ***12 months*** Early mobilization: 47 (19, 4–88) Late mobilization: 50 (11, 33–73) p-value: 0.57 ***6 months*** Early mobilization: 46 (17, 16–85) Late mobilization: 47 (12, 26–68) p-value: 0.74	
Arora et al 2011 [3] Austria	**Injury** Dorsally displaced distal radius fractures **Design** Randomized controlled study **Aim** To compare ORIF using a volar locking plate with closed reduction and plaster cast	**Participants** Inclusion: unstable dorsally displaced distal radial fractures. Age >65 years. Low energy trauma, independent living, available for follow-up examinations Exclusion: Age<65 years, living in nursing home; need for help in daily living activity, unable to travel on own to clinic for follow-up visits, multiple medical comorbidities,	**Open reduction and internal fixation (ORIF) with a volar locking plate** Volar plate through a palmar approach, postop splint 21 days **Participants** n=45 **Drop-out rate** n=9 (4 died; 5 lost to follow-up) **Side effects**	**Closed reduction and cast immobilization** Immobilization in a below-the-elbow plaster cast for 5 weeks **Participants** n=45 **Drop-out rate** n=8 (2 died; 6 lost to follow-up) **Side effects**	***6 months:*** **DASH mean (SD)** ORIF: 12.2 (14.4) Cast: 12.2 (17.0) p-value: 0.94 **PRWE mean (SD)** ORIF: 27.7 (32.0) Cast: 31.4 (33.0) p-value: 0.63 ***12 months:*** **DASH mean (SD)** ORIF: 5.7 (11.11) Cast: 8.0 (9.3) p-value: 0.34	Low

	Time to follow-up 6 weeks, 12 weeks, 6 and 12 months **Performed (yrs)** 2005–2008	previous fractures of the wrist. Bilateral, open and ipsilateral limb fracture/injuries. Volar angulated fractures (Smith type) n=90 were randomized Operative treatment n=45 Mean age: 75.9 (65–88) 28 women and 8 men Non-operative treatment n=45 Mean age: 77.4 (65–89) 27 women and 10 men	n=13 (n=5 extensor tenosynovitis; n=4 flexor tenosynovitis; n=1 EPL rupture; n=1 carpal tunnel syndrome; n=2 CRPS)	n=5 (n=5 CRPS)	**PRWE mean (SD)** ORIF: 12.8 (23.2) Cast:14.6 (22.8) p-value: 0.73 **Grip strength mean (SD)** ORIF: 22.2kg (6.3) Cast:18.8kg (5.8) p-value: 0.02 **Complications** The number of complications was significantly higher in the operative treatment group (13 compared with 5, p<0.05)	
Atroshi et al 2006 [4] Sweden	**Injury** Dorsally displaced distal radius fractures **Design** Randomized controlled study **Aim** To compare wrist-bridging with non-bridging external fixation **Time to follow-up** 10, 26 weeks and 1 year	**Participants** Inclusion: women >50 years and men >60 years or older, dorsally displaced distal radius fracture, extra articular or intraarticular with at least 2 large articular fragments, dorsal angulation of ≥20 degrees and/or radial shortening (ulnar variance) of ≥5 mm Exclusion: articular step-off>2mm, additional fractures, previous fracture same radius, high energy, nerve/tendon injuries abuse, cognitive	**Non-bridging external fixation** Closed fracture reduction. Percutaneous insertion of non-bridging Hoffmann II Compact external fixator. No additional fixation was used. 6 weeks fixation time. **Participants** n=19 **Drop-out rate** n=1 (illness) **Side effects**	**Wrist-bridging external fixation** Closed fracture reduction. Percutaneous insertion of bridging Hoffmann external fixator. No additional fixation was used. 6 weeks fixations time. **Participants** n=19 **Drop-out rate** n=1 (illness) **Side effects**	**1 year** **DASH, mean (SD)** Wrist-bridging: 7 (8) Non-bridging: 11 (12) p-value: 0.4 **SF-12 mean (SD)** Wrist-bridging: 48 (10) Non-bridging: 49 (7) p-value: 0.8 **Grip strength (kg), mean (SD)** Wrist-bridging: 22 (8) Non-bridging: 27 (13) p>0.1 **26 weeks** **DASH, mean (SD)** Wrist-bridging: 10 (10)	Low

	Performed (yrs) 1998–2002	difficulties and other sever illness n=38 randomized 31 women and 7 men Wrist-bridging Mean age: 71 (57–84) Non-bridging Mean age: 70 (55–86)	n=9 (pin site infections)	n=9 (6 pin site infections; 1 transient numbness in the radial sensory nerve distribution; 1 metacarpal fracture; 1 addition of pin due to fracture displacement)	Non-bridging: 19 (20) p-value: 0.2 **SF-12 mean (SD)** Wrist-bridging: 46 (10) Non-bridging: 45 (10) p-value: 0.8 **Grip strength (kg), mean (SD)** Wrist-bridging: 19 (6) Non-bridging: 23 (10) p>0.1	
Azzopardi et al 2005 [5] United Kingdom	**Injury** Distal radius fracture AO–A3 or Frykman types I and II **Design** Randomized controlled study **Aim** To compare plaster cast alone with percutaneous pinning and plaster cast **Time to follow-up** 5 weeks and 1 year **Performed (yrs)**	**Participants** Inclusion: >60 years of age, >20 degrees dorsally displaced extra-articular fractures of the distal radius Exclusion: dementia, psychiatric illness, previous fractures to either wrist, open fractures n=54 Closed reduction Mean age: 71 (9) n=27 25 women and 2 men Percutaneous pinning Mean age: 72 (8) n=27	**Percutaneous pinning** Closed reduction + interfragmentary fixation with 1.6 mm Kirschner (K-) wires. 5 weeks immobilisation in below-the-elbow cast **Participants** n=27 **Drop-out rate** n=6 patients (in sum from both groups) **Side effects** n=1 (early K-wire removal due to pin track infection)	**Closed reduction** Closed reduction and 3-point fixation in a below-the-elbow plaster cast for 5 weeks **Participants** n=27 **Drop-out rate** n=6 patients (in sum from both groups) **Side effects** n=1 (re-reduction+pinning (crossover))	**Grip strength mean (SD) 1 year % of the uninjured side** Percutaneous pinning: 77 (21) Closed reduction: 72 (17) p-value: 0.54 **SF-36; physical score (SD) 1 year** Percutaneous pinning: 42.2 (9.7) Closed reduction: 38.2 (11.2) p-value: 0.27 **SF-36; mental score (SD) 1 year** Percutaneous pinning: 51.0 (13.2) Closed reduction: 50.4 (8.6) p-value: 0.35 **Activity of daily living, (ADL) unilateral (SD) 1 year** Percutaneous pinning: 7.6 (1.2) Closed reduction: 7.4 (1.3) p-value: 0.43	Low

	1997–2000	23 women and 4 men			**Activity of daily living (ADL), bilateral (SD) 1 year** Percutaneous pinning: 9.7 (2.2) Closed reduction: 9.4 (2.5) p-value:0.74	
Bartl et al 2014 [6] Germany	**Injury** Distal radius fracture AO fracture types 23–C1–C3) **Design** Randomized multicentre controlled study **Aim** To compare open reduction with volar locking plate fixation with nonsurgical treatment **Time to follow-up** 3 months and 1 year **Performed (yrs)** 2008–2012	**Participants** Inclusion: >65 years of age, closed, unstable intra-articular distal radius fractures (AO-23 C1, C2, C3), interval of no more than one week from injury to randomization. Exclusion: Patients with fractures that, in the opinion of the responsible surgeon, could not be treated adequately with a cast; patient's preference for one of the treatment options; Extra-articular, open or pathological fractures; Patients not suitable for general anesthesia; dementia or neuropsychological disease body mass index > 35 n=185 for randomisation 153 women and 21 men ORIF: mean age (SD): 75.3 years (6.7)	**Open reduction and volar angle-stable plate osteosynthesis (ORIF)** Volar locking plate through Henry´s approach **Participants** n=94 68 analysed after one year in non-surgical group **Drop-out rate** n=28 (8 missing; 18 drop-out; 2 to cast group) **Side effects** n=7 (n=4 malposition of implant necessitating revision; n=1 rupture of tendons; n=1 wound healing disorder; n=1 carpal tunnel syndrome)	**Closed reduction and casting** Dorsoradial plaster cast for 6 weeks. The protocol permitted conversion to secondary surgical treatment in the case of significant loss of reduction or pronounced joint incongruence **Participants non-surgical group** n=91 81 analysed after one year in non-surgical group **Drop-out rate** n=47 (n=3 missing; 7 drop-out; 37 reassessed to surgical group) **Side effects** n=47 (n=37 reduction loss necessitating revision; n=2	**DASH (SD), 1 year** ORIF: 14.0 (16.1) Nonsurgical: 19.0 (21.3) Cohens d: 0.26 p-value: 0.102 **SF-36 PCS, 1 year** ORIF: 48.6 (10.4) Nonsurgical: 45.3 (11.3) Cohens d: 0.30 p-value: 0.058 **SF-36 MCS, 1 year** ORIF: 53.8 (7.6) Nonsurgical: 53.6 (9.1) Cohens d: 0.02 p-value: 0.902 **EQ-5D, 1 year** ORIF: 0.89 (0.21) Nonsurgical: 0.89 (0.18) Cohens d: 0.00 p-value: 0.508 **DASH (SD), 3 months** ORIF: 22.7 (16.7) Nonsurgical: 28.2 (20.5) Cohens d: 0.36 p-value: 0.071 **SF-36 PCS (SD) 3 months**	Moderate

		Non-surgical: mean age (SD): 74.4 years (7.1) Intention-to-treat analysis of 149 (68 ORIF; 48 non-surgical and 33 conversion group)		malposition; n=2 rupture of tendons; n=3 nerve lesion; n=2 carpal tunnel syndrome; n=1 skin pressure mark)	ORIF: 44.5 (8.4) Nonsurgical: 42.0 (10.6) Cohens d: 0.16 p-value: 0.096 **SF-36 MCS (SD), 3 months** ORIF: 53.7 (8.7 Nonsurgical: 54.0 (10.1) Cohens d: 0.16 p-value: 0.807 **EQ-5D (SD), 3 months** ORIF: 0.90 (0.14) Nonsurgical: 0.87 (0.18) Cohens d: 0.19 p-value: 0.190 ITT violated 37 crossovers, 44 remaining	
Boons et al 2012 [7] The Netherlands	**Injury** Neer's type 4 proximal humerus fracture **Design** Randomized controlled study **Aim** To compare non-operative treatment with hemiarthroplasty **Time to follow-up** 3 month and 1 year	**Participants** Inclusion: >65 years; displaced proximal humeral 4-part Fractures (Neer) Exclusion: previous shoulder condition (either arm) ASA IV; mental disorders; pathologic or open fracture; Other injuries to the same limb; non Dutch-speaking n=50 **Hemiarthroplasty**	**Hemiarthroplasty** Cemented Global1 FX shoulder fracture endoprosthesis was inserted through a deltopectoral approach **Participants** n=24 **Drop-out rate** n=1 (Stroke at 5 weeks) **Side effects** n=1 postoperative complication; n=4	**Non-operative treatment** Shoulder immobilizer for 6 weeks **Participants** n=23 **Drop-out rate** n=2 (natural death and weakness) **Side effects** n=20 bony union; n=2 nonunion or osteonecrosis; n=3 nonunion	**Constant-Murley score, mean (SD), 1 year** Hemiarthroplasty: 64 (15.8) Non-operative: 60 (17.6) p-value: 0.413 **Constant-Murley score, mean (SD), 3 month** Hemiarthroplasty: 48 (13.4) Nonoperative: 54 (14.1) p-value: 0.125	Low

	Performed (yrs) 2004–2009	Mean age: 76.4 (5.6) 24 women and 1 man **Nonoperative treatment** Mean age: 79.9 (7.7) 23 women and 2 men	malposition; n=3 tuberosity to low; n=1 tuberosity to high; n=5 secondary superior migration of the greater turbosity; n=1 proximal migration of hemiarthroplasty; n=2 nonunion			
Buecking et al 2014 [8] Germany	**Injury** 2, 3 and 4 parts displaced proximal humeral fractures **Design** Randomized controlled study **Aim** To compare the deltoid-split approach with the deltopectoral approach for internal fixation of displaced humeral fractures with a polyaxial locking plate **Time to follow-up** 6 and 12 months **Performed (yrs)** 2009–2011	**Participants** Inclusion: 2, 3 and 4 parts displaced proximal humeral fractures Exclusion: undisplaced fracture; <18 years old; glenohumeral dislocation; concomitant ipsilateral fractures of the arm or forearm; malignancy-related fractures; multiple trauma; plan for prosthesis surgery n=120 Deltoid-split; Mean age: 69 (66–72), 48 women and 12 men Deltopectoral; Mean age: 67 (63–71), 44 women and 16 men	**Deltoid-split** Anterolateral 3-cm deltoid split and 2 small incisions for the 3 locking screws in the diaphysis of the humerus **Participants** n=60 **Drop-out rate** n=5 1 patient died during follow-up, 4 patients were not reachable **Side effects** n=3 screw perforation; n=5 head implant loosening; n=9 plate removals	**Deltopectoral** The fracture was exposed through a classical anterior approach. The 10–12 cm incision began at the tip of the coracoid process and ran medially in the direction of the deltoid muscle **Participants** n=60 **Drop-out rate** n=8 3 patients died during follow-up, 5 patients were not reachable **Side effects** n=2 head implant loosening; n=4 shaft implant loosening;	**Constant scores** (95% CI) ***12 months*** ***2-part fractures*** Deltoid-split: 74 (59; 88) Deltopectoral: 74 (38; 110) p-value: 0.99 ***3- and 4-part fractures*** Deltoid-split: 83 (75; 90) Deltopectoral:72 (63; 81) p-value: 0.07 ***6 months*** ***2-part fractures (n=30)*** Deltoid-split: 71 (59; 82) Deltopectoral: 63 (47; 78) p-value: 0.34 ***3- and 4-part fractures (n=90)*** Deltoid-split: 67 (60; 73) Deltopectoral:65 (57; 72) p-value: 0.72 **Activity of daily living (ADL) score (95% CI)** ***6 months***	Low

				n=1 deep infection; n=8 plate removal	2-part fractures Deltoid-split: 21 (17; 24) Deltopectoral: 18 (12; 23) p-value: 0.25 3- and 4-part fractures Deltoid-split: 18 (16; 20) Deltopectoral: 18 (15; 20) p-value: 0.62 ***12 months*** 2-part fractures Deltoid-split: 18 (13; 23) Deltopectoral: 18 (10; 25) p-value: 0.93 3- and 4-part fractures Deltoid-split: 19 (16; 21) Deltopectoral: 17 (14; 20) p-value: 0.27	
Cassidy et al 2003 [9] USA	**Injury** Distal radius fractures, extra articular and dorsally displaced **Design** Randomized controlled study multicentre **Aim** To compare closed reduction and immobilization with and without	**Participants** Inclusion: an unstable and/or displaced distal radius fracture, >45 years, low energy trauma, independent living, isolated injury, treatment administrated within five days of injury, anatomic reduction within two mm of radial length, a volar angle of 0° to 28°, volar cortical alignment, and normal joint congruity	**Closed reduction and immobilization with Norian SRS cement** Closed reduction, percutaneous pins with enhancement of SRS cement. A below-the-elbow cast was worn for 2 weeks followed by a removable splint for 4 additional weeks **Participants** n=161	**Closed reduction and immobilization without Norian SRS cement** Closed reduction of the fracture followed by a below-the-elbow cast or an external fixator, and/or percutaneous pins. Immobilization 6–8 weeks postoperatively. **Participants** n=162	**SF-36** 1 year: no difference between groups 6–8 weeks: intervention group significantly higher than the control patients ($p<0.05$) **Grip strength** 1 year: no differences between groups 3 months: no differences between groups 6–8 weeks: intervention group 8 kg (37%) Control group 4.5 kg (21.5%) $P<0.0001$ ***Green and O´Brian, functional outcome1 year*** Norian: 77 points Control: 78 points	Low

	Norian SRS (Skeletal Repair System) cement **Time to follow-up** 1, 2, 4 and 6–8 weeks and 3, 6 and 12 months **Performed (yrs)** 1995–1998	Exclusion: a Smith or Barton fracture; a nondisplaced or stable fracture, a previous wrist fracture in the injured limb within the last 12 month, a concomitant limb fracture, ipsilateral ulnar fracture, an open fracture, nerve or blood vessel injury, or infection at the operative site. Receiving radiation therapy or chemotherapy, receiving anticoagulation therapy, medication known to affect skeletal metabolism, social problems n=323 Treatment group: Mean age: 63.5 129 women and 32 men Control group: mean age: 63.7 143 women and 19 men	**Drop-out rate** n=16 (lost to follow-up and 2 of them died) **Side effects** n=74 (Infection n=4; loss of reduction n=46; neuropathy n=23; tendinopathy n=12)	**Drop-out rate** n=13 (lost to follow-up and 1 died) **Side effects** n=82 (Infection n=27; loss of reduction n=40; neuropathy n=32; tendinopathy n=8)	**Complications** No differences were seen in total number of complications, including loss of reduction. Extra osseous Norian SRS was associated with complications	
Chen et al 2016 [10] China	**Injury** four-part proximal humeral fractures and/or fracture dislocation **Design**	**Participants** Inclusion: acute 4-part PHF, and/or fracture dislocation; bone mineral density (BMD) less than–3.0	**Intramedullary fibular allograft (IFA) with locking compression plates (LCPs)** The deep-frozen and freeze-dried IFA was obtained from the	**Shoulder hemi-arthroplasty (HA)** The HA prosthesis (LINK, Germany) was used for patients in HA group. A bone graft was placed in the tuberosity to	**DASH** *Statistically significantly differences between the groups **24 months** IFA and LCPs: 10.33 ± 8.21 HA: 7.11 ± 5.64* **12 months**	Low

	Randomized controlled study **Aim** To compare intramedullary fibular allograft (IFA) with locking compression plates (LCPs) versus shoulder hemi-arthroplasty (HA) **Time to follow-up** 3, 6, 12 and 24 months **Performed (yrs)** 2010–2012	Exclusion: previous history of shoulder surgery; chronic non-union; addiction of cigarettes and drugs; failure to cooperate n=60 32 women and 28 men IFA and LCPs group: Mean age (range): 68 (51.2–73.1) 17 women and 13 men HA group mean age (range): 64 (53.1–81.3) 15 women and 15 men	bone bank. The LCP was placed 5–10 mm lateral to the bicipital groove, and 15–20 mm inferior to the vertex of the humerus head. The placement of head-locking screws was in the articular segment. Meanwhile, distal screws were put into the shaft **Participants** n=30 **Drop-out rate** n=2 **Side effects** n=1 loss reduction (varus displacement); n=1 avascular necrosis; n=1 screw perforation	restore the humeral off-set. The tuberosities were then sutured to 1 another and to the humeral shaft with non-absorbable horizontal and vertical sutures **Participants** n=30 **Drop-out rate** n=2 **Side effects** n=2 superficial infection; n=4 shoulder stiffness; n=2 tuberosity migration	IFA and LCPs: 9.89 ± 8.57 HA: 7.32 ± 3.21 **6 months** IFA and LCPs: 10.11 ± 7.11 HA: 8.97 ± 9.14* **3 months** IFA and LCPs: 9.32 ± 9.11 HA: 10.8 ± 8.32 Data on constant-Murley score in the 2 groups at the 24 months follow-up is also available in the article	
Costa et al 2014 [11] United Kingdom	**Injury** Dorsally displaced distal radius fracture **Design** A multicenter randomized controlled trial	**Participants** Inclusion: dorsally displaced fracture of the distal radius within 3 cm of the radiocarpal Exclusion: wrist joint surface comminution; treatment >2w after injury;	**Kirschner wires** Percutaneous pinning with the size, number of wires, the insertion technique, and the configuration of wires as decided by the surgeon. A plaster cast	**Volar locking plate fixation** Volar locking plate through Henry's approach. Supplementary use of cast at the discretion of the surgeon **Participants**	**12 month follow-up for all participants** **PRWE Mean (SD)** Wire: 15.3 (15.8) Plate: 13.9 (17.1) Raw: –1.4 Adjusted: –1.3 (–4.5; 1.8) P=0.398 DASH and EQ-5D data are also available in article for mean age 59.7.	Low

	Aim To compare Kirschner wire fixation with locking plate fixation **Time to follow-up** 1 year **Performed (yrs)** 2011–2012	open fractures; inability to complete questionnaires n=461 (Total) n=314 (Age ≥50) identified a priori as a separate subgroup Wire: Mean age: 59.7 191 women, 39 men Plate: Mean age: 58.3 194 women, 37 men	**Participants** n=230 (baseline) n=211 (at 12 month) n=159 (age ≥50) **Drop-out rate** n=14 loss to follow-up; n=3 withdrawn; n=3 died; n=8 unresponsive	n=231 (baseline) n=204 (at 12 month) n=155 (age ≥50) **Drop-out rate** n=15 loss to follow-up; n=1 withdrawn; n=1 died; n=11 unresponsive	No significant difference in DASH score (p=0.051 at 12 months) as well as for EQ-5D **DASH Mean (SD) all participants** 12 months Wire: 16.2 (17.9) Plate: 13.0 (15.6) 6 months Wire: 21.1 (18.5) Plate: 19.2 (17.5) 3 months Wire: 31.1 (20.6) Plate: 28.9 (21.1) **EQ-5D Mean (SD) (n=194 plate and 204 wire)** 12 months Wire: 0.8 (0.2) Plate: 0.9 (0.2) 6 months Wire: 0.8 (0.2) Plate: 0.8 (0.2) 3 months Wire: 0.7 (0.2) Plate: 0.8 (0.2) **Complications** Rates of complications did not differ between study groups	
Fialka et al 2008 [12] Austria	**Injury** Proximal humerus fracture, 11 C according to the	**Participants** Inclusion: planned for operative management of an acute 4-part proximal	**EPOCA shoulder prosthesis** Deltopectoral incision, cemented	**HAS prosthesis** Deltopectoral incision, cemented HAS prosthesis,	**Subjective outcomes and objective outcomes** Constant score (time point not stated) EPOCA: 70,4 HAS: 46,2	Moderate

	AO/ASIF classification **Design** Randomized controlled study, Single centre **Aim** To compare 2 different prosthetic systems for shoulder arthroplasty for fractures **Time to follow-up** 12 days, 3 weeks and 6 weeks, and 6 and 12 months **Performed (yrs)** The year when study was performed was not stated	humeral fracture (11 C according to the AO/ASIF classification); isolated fractures of the proximal humerus; >50 years; no previous problems of either shoulder Exclusion: concomitant vascular or neurologic injuries of the involved extremity; prior operative procedures, neurologic or mental disorders; drug abuse n=40 baseline 3 patients died, and 2 were lost to follow-up n=35 28 women and 7 men EPOCA-group; Mean age: 74 (58–88) HAS-group; Mean age: 73 (56–85)	EPOCA shoulder hemi-prosthesis, fixation of tubercles with wire cables through a medial and a lateral hole in the stem **Participants** n=18 **Drop-out rate** Not reported **Side effects** n=2 deep infection	fixation of tubercles was performed by use of trans osseous braided nonabsorbable sutures **Participants** n=17 **Drop-out rate** Not reported **Side effects** n=2 scheduled for reoperation because of persistent pain	p=0.001	
Fjalestad et al 2012 [13] Norway	**Injury** Displaced 3- or 4-part proximal humeral fractures, AO–B2 or C2 **Design**	**Participants** Inclusion: aged >60 years; 3- or 4-part proximal humeral fractures, AO-B2 or C2 with 45 deg or 1 cm displacement	**Open reduction and internal fixation using an angular stable plate and cerclages** Open reduction (deltopectoral approach) and internal	**Nonoperative treatment** The shoulder was immobilised in Velpeau bandage. If displacement between the head and metaphyseal shaft	**Total Constant score, Max: 100 points, (95% CI), 12 month** Surgical: 52.3 (43.2; 61.2) Conservative: 52.2 (44.6; 59.7) **American Shoulder and Elbow Surgeons (ASES score, max 24 points) for 12 months for injured shoulder, score (SD)**	Low

	Randomized controlled study **Aim** To compare angular stable plate and cerclages or conservative treatment **Time to follow-up** 3, 6 and 12 months **Performed (yrs)** 2003–2008	Exclusion: additional injuries, previous injuries to either shoulder, drug abuse, dementia, neurological disease, contraindications to surgery n=50 Surgery: Mean age: 72.2 (60–86) 20 women and 5 men Conservative: Mean age: 73.1 (60–88) 24 women and 1 men	fixation using an angular stable plate (generic, not anatomy specific) and cerclages. Instructed physical therapy started the third postoperative day **Participants** n=25 **Drop-out rate** n=2 **Side effects** 2 surgical patients died within 3 months from unrelated causes; 1 patient required 2nd surgery (hardware failure	fragment exceeded 50% of the diaphyseal diameter closed reduction was performed with 48 hours. Physical therapy started on the 15th postoperative day **Participants** n=25 **Drop-out rate** n=0 **Side effects** n=1 required ORIF (secondary displacement); n=2 pain-free nonunions	Surgical: 14.8 (6.6) (non-injured: 23.4 (1.6) Conservative: 15.5 (6.9) (non-injured: 23.2 (1.6) p-value: 0.71	
Fjalestad et al 2014 [14] Norway	**Injury** proximal humeral fracture (AO/OTA group B2 or C2) **Design** Randomized controlled study **Aim** The aim was to perform a 2-years extension of a	**Participants** Inclusion: aged >60 years; 3- or 4-part proximal humeral fractures, AO–B2 or C2 with 45 deg or 1 cm displacement Exclusion: additional injuries, previous injuries to either shoulder, drug abuse, dementia, neurological disease,	**Angular stable implant** Open reduction (deltopectoral approach) and internal fixation using an angular stable LCP plate of the AO basic type (Synthes®, Switzerland) and cerclages. Instructed physical therapy started the	**Conservative** Patients were immobilized in a modified Velpeau bandage (a sling bandage stabilizing the arm against the chest for 2 weeks before training started, If the displacement between the head and metaphyseal fragment	***Health-related quality of life (1 represent best health)*** The difference in 15-D between the surgical and conservative treated groups was 0.022 (implant: 0.841, conservative: 0.819) (p=0.549) at 12 months and 0.024 (p=0.436) at 24 months, both nonsignificant, but in favor of the surgical group ***The modified ASES self-assessment form (max 24)*** For surgery group, the mean self-assessment (ASES ADL score) at 12 months was 14.8 (95% Cl 11.9; 17.6) and at 24 months, 14.8 (95% Cl 12.0; 17.7). Patients' self-assessment at 12 months	–

	randomized comparing operative and conservative treatment **Time to follow-up** 2 years **Performed (yrs)** 2003–2008	contraindications to surgery n=50 Surgery: Mean age: 72.2 (60–86) 20 women and 5 men Conservative: Mean age: 73.1 (60–88) 24 women and 1 men	third postoperative day **Participants** n=25 **Drop-out rate at 2 years follow-up** n=2 **Side effects** No complications occurred after the 1-year control, thus presented in study due Fjalestad 2012 above	(main fragments) exceeded 50% of the diaphyseal diameter, closed reduction under fluoroscopic control was performed in the operating theater under intravenous analgesia as part of the conservative treatment shortly after admission **Participants** n=25 **Drop-out rate at 2 years follow-up** n=2 **Side effects** No complications occurred after the 1-year control, thus presented in study due Fjalestad 2012 above	was mean 15.5 (95% CI 12.7; 18.4) for the conservative group, whereas at 24 months, 14.9 (95% Cl 12.7; 18.4). There was no significant difference in either group during the 2-year period ***Constant score difference (CSD)*** There was no significant difference between surgical and conservative treatment after 12 months (CSD12 equal 35.2 vs. 32.8, difference 2.4, p=0.62) or 24 months (CSD24 equal 33.3 vs. 32.6, difference 0.7, p=0.71). The slight difference was in favor of conservative treatment For the surgical group, mean change in function over time is statistically significant from 6–12 months. During the second year, there was no significant additional change in function in either treatment group, and subjects bad not achieved pre-fracture function (CS=88.2 for surgery group and CS=81.8 for conservative group)	
Foldhazy et al 2010 [15] Sweden	**Injury** Dorsally displaced distal radius fracture **Design** Randomized controlled study	**Patients** Inclusion: 60–85 years; acute distal radial fracture; low energy trauma; dorsal angulation at least 40° from normal or radius shortening at least 5 mm	**External fixation** Closed reduction, standard external fixation **Participants** n=28 **Drop-out rate**	**Closed reduction and plaster casting** Closed reduction using regional anesthesia and dorsal below the elbow plaster splint. The plaster was retained for 5 weeks	**Green and O'Brian/Cooney score** mean (SD), 1 year External fixation: 70.2 (18.6) Plaster group: 72.1 (12.9) p=0.67 **Grip strength and range of motion 1 year** No differences in grip strength between groups (p=0.94).	Low

	Aim To compare external fixation with traditional plaster treatment **Time to follow-up** 2, 6 and 12 month **Performed (yrs)** Time when study was performed not stated	Exclusion: fracture >3 days, previous hand dysfunction; Cognitive disorders; Inability to perform ADL n=59 53 women and 6 men were randomized Plaster group mean age: 70 years (62–81) 29 women and 2 men External fixation mean age: 73 years (60–85) 24 women and 4 men	n=6 (5 women and 1 man) **Side effects** n=7 (n=4 pin track infection; n=1 EPL rupture; n=1 radial nerve injury; n=1 CRPS)	**Participants** n=31 **Drop-out rate** n=2 women **Side effects** n=3 (n=1 Carpal tunnel syndrome; n=2 CRPS)	No differences in grip strength could be found between groups in earlier follow-ups. **Complications** External fixation group: 7/22 Plaster group: 3/29 This difference, was not statistically significant (p=0.08)	
Goehre et al 2014 [16] Germany	**Injury** Distal radius fracture AO fracture type A2, A3 or C1 **Design** Randomized controlled study **Aim** To compare fixed-angle volar plates with K-wires **Time to follow-up** 3, 6, and 12 months	**Participants** Inclusion: aged over 65 years; unstable extra-articular fracture of the distal radius; simple articular fracture Exclusion: associated carpal injuries; multiple injuries; pre-existing functional deficits; severe n=40 Plate fixation median age: 71.3 years (5.7)	**Fixed-angle volar plates** LCP Distal Radius System 2.4 (Synthes, Zuchwil, Switzerland) **Participants** n=21 **Drop-out rate** n=0 **Side effects** n=4 (n=3 Carpal tunnel syndrome; 1 carpal tunnel surgical release)	**K-wires using a combined Kapandji and Willenegger technique** 1.6–2.0 mm wires via an intrafocal Kapandji, trans-styloidal Willenegger, or combined technique. Cast 6 weeks post-operatively **Participants** n=19 **Drop-out rate** n=0	**DASH 1 year** Mean 3,0 in both groups **Castaing score** 16 of 21 patients with plate fixation and 17 of 19 patients with K-wire fixation present good results **Grip strength 12 months median, % of other side** K-wire group: 88% (range 40–100%) Plate group: 88% (range 27–100%) (p=0.87) **Operation time** median skin-to-skin operation Plate group: 60 (range 31–130) minutes in the plate K-wire: 23 (range 10–55) minutes (p<0.01)	Moderate

	Performed (yrs) 2004–2006	K-wire median age: 73.8 years (8.9) The participants gender is not stated in the article		**Side effects** n=3 (n=1 loss of reduction; n=2 Carpal tunnel syndrome)		
Gracitelli et al 2016 [17] Brazil	**Injury** Displaced 2- and 3-part proximal humeral fractures **Design** Randomized controlled study **Aim** To compare locking plates and locking intramedullary nails **Time to follow-up** 3, 6 and 12 months **Performed (yrs)** 2011–2014	**Participants** Inclusion: Age 50–85 years; proximal humerus fracture displacement ≥1 cm or 45° of angulation between the head and diaphysis of the humerus, with or without involvement of the greater tuberosity; treatmentsurgically ≤21 days after the injury n=72 (randomized) n=65 (analysed) 47 women and 18 men Nail group mean age: 64.5 years (9.3) Plate group mean age: 66.4 years (8.1)	**Nail group** The Centronail (Orthofix, Verona, Italy) intramedullary nail with 3 proximal locking screws was used, introduced via a longitudinal anterolateral transdeltoid approach **Participants** n=36 (29 analysed) **Drop-out rate** Did not respond (n=3); died (n=1) **Unknown (n=3)** **Side effects** Complications were seen in 11 patients (n=4 complete rotator cuff tear; n=3 involvement of the supraspinatus tendon; n=6 reoperation; n=1 CRPS; n=1 infection; n=4 loss of reduction; n=12 hardware	**Plate group** The PHILOS (DePuy-Synthes, Solothurn, Switzerland) stainless steel plate was used, with 3 holes for the diaphysis, which was introduced via the deltopectoral approach **Participants** n=36 (32 analysed) **Drop-out rate** Did not respond (n=5); died (n=2) **Side effects** Complications were seen in 7 patients (n=2 complete rotator cuff tear; n=2 stiffness; n=1 reoperation; n=2 supraspinatus tear; n=1 refracture; n=1 insufficient reduction; n=1 loss of reduction)	**DASH points, mean (SD)** ***12 months*** Nail group: 18.1 (18.8) Plate group: 14.3 (13.0) n.s. ***6 months*** Nail group: 18.4 (16.1) Plate group: 20.0 (12.5) n.s. ***3 months*** Nail group: 32.7 (16.4) Plate group: 34.1 (17.3) n.s. **Complications: See side effects.** 38 complications were recorded; 28 in the nail group (n=11) and 10 in the plate group (n=7), P=.001. Difference in reoperation significant (p=0.041)	Low

			problems; n=2 osteonecrosis)			
Gradl et al 2013 [18] Germany	**Injury** Distal radius fracture AO fracture type A3 and C1–C3. **Design** Randomized controlled study **Aim** To compare non-bridging external fixation with palmar angular stable plating **Time to follow-up** 6 and 12 months **Performed (yrs)** 2005–2006	**Participants** Inclusion: dorsally displaced (>20°) extra-articular A3 and intra-articular C1–C3 distal radius fractures Exclusion: dorsal or volar sharing fracture; type B fracture; previous wrist trauma n=102 89 women and 13 men Mean age: 63 years (18–88) **Lost to follow-up** because of death (n=2), moving houses (n=3), and non-respondence (n=5)	**Non-bridging external fixation** Non-bridging external fixation (AO small Fixator; Mathys Medical, Bettlach, Switzerland fixation technique) The external fixator was removed as an outpatient procedure 7 weeks after surgery **Participants** n=50 **Drop-out rate** Not stated **Side effects** n=5 superficial infection; n=2 complex regional pain syndrome type 1; n=2 rupture of the extensor pollicis longus (EPL); n=1 carpal tunnel release; overall re-operation rate was 6% (3 patients)	**ORIF using a volar fixed angle plate** ORIF using a volar fixed angle plate (2.4 mm Synthes®, Mathys Medical, Bettlach, Switzerland). Volar splint for 3 days **Participants** n=52 **Drop-out rate** Not stated **Side effects** Hardware removal n=13 patients (25%) due to symptomatic hardware; n=2 complex regional pain syndrome type 1; n=1 rupture of the EPL tendon; n=4 Carpal tunnel syndrome (CTS); n=3 carpal tunnel release; overall re-operation rate was 36.5% (19 patients)	**Castaing score 1 year, mean (SD)** ***All patients*** External fixation: 1.65 (0.28) ORIF: 1.71 (0.3) p-value: 0.66 **Castaing score, mean (SD)** ***Osteoporotic patients*** External fixation: 1.37 (0.28) ORIF: 2.08 (0.9) p-value: 0.66 **Gartland and Werley score 1 year, mean (SD)** ***All patients*** External fixation: 1.18 (0.3) ORIF: 1.4 (0.35) p-value: 0.3 **Gartland and Werley score 1 year, mean (SD)** ***Osteoporotic patients*** External fixation: 0.47 (0.25) ORIF: 2.42 (1.06) p-value: 0.06 **Grip strength percentage of contralateral side, mean (SD), 12 month** External fixation: 86.8 (2.8) ORIF: 84.1 (3.3) p-value: 0.68 **Grip strength percentage of contralateral side, mean (SD), 6 month** External fixation: 72.2 (3.8) ORIF: 80.2 (2.9)	Low

					p-value: 0.23 **Time of surgery** External fixation: 43.1±1.5 min Plate fixation: 58.5±2.9 (p<0.05)	
Gradl et al 2014 [19] Germany	**Injury** Distal radius fracture AO type A3 **Design** Single-centre prospective randomized trial **Aim** To compare 2.4-mm volar locking plate fixation with intramedullary nail fixation **Time to follow-up** 8 weeks, 6 months, 1 year and 2 years **Performed (yrs)** 2005–2008	**Participants** Inclusion: aged >18 years, dorsally displaced (>20°) extra-articular distal radius fractures Exclusion: Not stated. n=152 randomized Volar plate: Mean age (SD): 61.4 (14) 50 women and 5 men Intramedullary nail: Mean age: 63.1 (15) 53 women and 13 men	**Volar locking plate fixation** Volar plate fixation was performed through a standard Henry approach **Participants** n=72 (55 analysed) **Drop-out rate** n=17 (lost to follow-up) **Side effects** 4 mild symptoms of Carpal tunnel syndrome requiring no further treatment. 2 Complex Regional Pain Syndrome. 2 Implant removal due to screw loosening or screw penetration. 1 EPL rupture 12 implant removals due to discomfort	**Intramedullary nail fixation** The fracture was manipulated and reduced by insertion of a Kapandji wire (radial styloid) and the intramedullary nail (Targon DR) was inserted according to the manufacturer's manual **Participants** n=80 (66 analysed) **Drop-out rate** n=14 (lost to follow-up) **Side effects** 1 mild symptoms of Carpal tunnel syndrome requiring no further treatment. 1 Complex Regional Pain Syndrome. 1 cellulitis, which resolved with local wound care.	***Castaing Score, points, mean (SD), follow-up time not stated*** Volar plate: 1.7 (11.1) Targon DR: 2.4 (2.5) p-value: 0.07 ***Gartland & Werley Score, points (SD), follow-up time not stated*** Volar plate: 2.3 (2.3) Targon DR: 2.7 (3.3) p-value: 0.52 **Grips strength:** Patients in both groups achieved 90% of grip strength of the unaffected side. No significant difference between groups was found ***Operation time (min)*** Volar plate: 49 (range 34–126) Targon DR: 45 (range 30–195) p-value: 0.04	Low

				1 Implant removal due to screw loosening or screw penetration		
Handoll et al 2015 [20] United Kingdom	**Injury** Displaced proximal humerus fractures **Design** Randomized controlled study **Aim** To compare surgical with non-surgical treatment **Time to follow-up** 2 years **Performed (yrs)** 2008–2011	**Participants** Inclusion:(aged ≥16 years; presenting<3 weeks; displaced fracture of the proximal humerus involving the surgical neck; treating surgeon considered surgical intervention Exclusion: associated dislocation of the injured shoulder joint; open fracture; lack of mental capacity to understand the trial or instructions for rehabilitation; comorbidities precluding surgery/anesthesia; clear indication for surgery such as severe soft-tissue compromise; multiple injuries (upper limb fractures); pathological fractures (other than osteoporotic) and terminal illness; and participant not resident in the hospital catchment area n=250 (randomized) 192 women and 52 men	**Surgical intervention** Plate fixation or intramedullary nailing or hemiarthroplasty at the discretion of the treating surgeon **Participants** n=125 (baseline) n=113 (6 months) n=111 (12 months) n=109 (24 months) **Drop-out rate** n=14 (1 year) n=19 (2 years) Side effects: See complications Mean operating time 113 minutes Type of surgery: Nail 4 (3.7%), plate and screws 90 (82.6%), hemiarthroplasty 10 (9.2%), other 5 (4.6%) Side effects:	**Non-surgical treatment:** Sling immobilisation for about 3 weeks or for as long as the treating clinician deemed necessary and active early rehabilitation **Participants** n=125 (baseline) n=119 (6 month) n=115 (12 month) n=109 (24 month) **Drop-out rate** n=10 (1 year) n=16 (2 years) **Side effects** See complications **Intervention** Collar and cuff 35 (28%), hanging cast 3 (2.4%), poly-sling 4 (3.2%), sling 78 (62.4%), missing 5 (4%) **Side effects**	T**he Oxford Shoulder Score**, mean (SD), assessed at 6, 12 and 24 months **6 months** Surgical: 36.07 (9.99) Non-surgical: 33.07 (11.0) **12 months** Surgical: 36.89 (10.78) Non-surgical: 36.45 (10.86) **24 months** Surgical: 38.25 (9.91) Non-surgical: 38.39 (10.96) **EQ-5D, mean (SD)** **Baseline:** Surgical: 0.43 (0.37) Non-surgical: 0.38 (0.37) **3 months** Surgical: 0.64 (0.25) Non-surgical: 0.63 (0.24) **6 months (n=111; n=114)** Surgical: 0.69 (0.24) Non-surgical: 0.63 (0.28) **12 months (n=109; n=109)** Surgical: 0.65 (0.30) Non-surgical: 0.68 (0.28)	Low

		n=231 192 women and 39 men Surgery mean age: 66.60 years (11.80) Non-surgery mean age: 65.43 years (12.09)	30 patients (24%) experienced at least 1 complication. The most common complication was metalwork (n=10) and posttraumatic stiffness (n=6)	23 patients (18%) experienced 1 complication over the trial period. Malunion (n=5), nonunion (n=5) and posttraumatic stiffness (n=5) were the most common complications	**24 months (n=108; n=10)** Surgical: 0.67 (0.30) Non-surgical: 0.69 (0.31) **12-item Short Form health survey (SF-12 PCS and SF-12 MCS),** mean (SD) SF-12 PCS, mean (SD), 6 months Surgical: 45.3 (10.01) Non-surgical: 42.7 (11.25) SF-12 PCS, mean (SD), 12 months Surgical: 45.2 (10.98) Non-surgical: 43.7 (10.98) SF-12 PCS, mean (SD), 24 months Surgical: 45.2 (11.30) Non-surgical: 44.1 (11.58) SF-12 MCS, mean (SD), 6 months Surgical: 49.2 (10.84) Non-surgical: 49.8 (11.46) SF-12 MCS 12 months Surgical: 48.8 (10.51) Non-surgical: 50.8 (10.67) SF-12 MCS 24 months Surgical: 50.1 (11.64) Non-surgical: 51.5 (9.96) **Complications** See side effects. There were no statistical significant difference differences between treatment groups except that there were a greater number of serious	

					non-fatal medical complications in the non-surgery group than in the surgery group (27 vs. 11)	
Hegeman et al 2004 [21] The Netherlands	**Injury** Distal radius fracture AO types C2 or C3 **Design** Randomized controlled study **Aim** To compare primary external fixation with plaster immobilization **Time to follow-up** 6 weeks, 3 months, 6 months, and 1 year **Performed (yrs)** 1998–2000	**Participants** Inclusion: unstable intra-articular distal radial fracture (AO–C2 or C3); Age between 55 and 80 years; dorsal angulation of more than 10 degrees; radial inclination of less than 20 degrees; positive ulnar variance of more than 3 millimeter Exclusion: previous distal radial fracture; unable to perform the functional evaluation External fixation mean age: 71 years (7.9) Plaster immobilization mean age: 69 years (8) n=32 29 women and 3 men	**Primary external fixation** Hofmann II Compact external fixator. The external fixator was removed after 6 weeks **Participants** n=15 **Drop-out rate** n=0 **Side effects** (n=1 persistent reflex sympathetic dystrophy; n=2 superficial infection; n=2 transient neuropraxia)	**Plaster immobilization** Closed reduction of the fracture and immobilization in a below elbow plaster for 6 weeks **Participants** n=17 **Drop-out rate** n=0 **Side effects** (n=1 transient neuropraxia; n=1 reflex sympathetic dystrophy)	**Gartland and Werley** No differences between the 2 groups at any stage **Grip strength hand, 1 year, mean (SD) expressed as the percentage of the uninjured side** External fixation: 71% (32) Plaster: 78% (19) p-value: 0.53 **Grip strength hand, 3 months, mean (SD) expressed as the percentage of the uninjured side** External fixation: 35% (19) Plaster: 60% (44) p-value: 0.53	Moderate
Jakubietz et al 2012 [22] Germany	**Injury** Distal radius fracture AO type C **Design** Randomized controlled study	**Participants** Inclusion: age >50; unilateral AO-type C fractures Exclusion: other injuries of the upper extremity; intercarpal injuries such as	**Volar plate group: Open reduction and internal fixation with a palmar, angle-stable plate** Open reduction and internal fixation with a palmar, angle-stable	**Dorsal plate group: Open reduction and internal fixation with the dorsal Pi-plate** Open reduction and internal fixation with a dorsal Pi-plate (AO-	**DASH score, 1 year** Volar plate group: 10.5 Dorsal plate group: 14.3 p-value: 0.093 **The Gartland-Werley score, 1 year** Volar plate group: 2.1 Dorsal plate group: 9.2	Moderate

	Aim To comparing dorsal Pi plates and palmar, angle-stable plates **Time to follow-up** 6 weeks, 3, 6 and 12 months **Performed (yrs)** Time when study was performed not stated	SL-ligament dissociation; fractures older than 8 days; open fractures and patients with premorbid conditions precluding surgical intervention n=50 drop-outs n=8 The Palmar Plate Group mean age: 67.7 years (52–92) 19 women and 3 men The Dorsal Plate Group mean age: 67.6 years (52–85) 17 women and 3 men	plate (Aptus Radius Plate, Medartis GmbH, Basel, Switzerland). Hardware was removed in all patients at 6 months **Participants** n=22 **Drop-out rate** n=3 **Side effects** 9 complications occurred in 6 patients; transient paranesthesia in the median nerve in 5 cases which resolved; n=2 Complex regional pain syndrome Type 1;.n=1 tendon irritation, n=1 adhesion of the FPL	ASIF Pi-Plate, Synthes, Bettlach, Switzerland). Hardware was removed in all patients at 6 months **Participants** n=20 **Drop-out rate** n=5 **Side effects** 11 complications occurred in 7 patients; n=1 transient radial nerve dysesthesia; n=1 median nerve irritation; n=3 CRPS; n=3 secondary displacements; n=2 EDC II ruptures	p-value: 0.001 **Grip strength hand, 1 year, expressed as the percentage of the uninjured side** Volar plate group: 95% Dorsal plate group: 75% p-value: 0.001	
Jakubietz et al 2011 [23] Germany	**Injury** Distal radius fracture AO type C **Design** Randomized controlled study **Aim**	**Participants** Inclusion: unilateral, intraarticular fractures of the distal radius; age over 50; dorsal comminution zone and at least 2 instability criteria Exclusion: Open fractures; additional	**Group I: Internal fixation (dorsal implant)** Dorsal implant only (Pi-Plate, Synthes Corporation) All implants were removed 6 months postoperatively	**Group II: Bone augmentation with granular beta-tricalcium phosphate (additionally to the implant)** Additionally to the implant augmentation with granular beta-tricalcium phosphate	**DASH1 score 12 months** Dorsal implant group: 14.26 Dorsal implant+bone augmentation: 21.72 No statistical significance between the groups **DASH2 score 12 months** Dorsal implant group: 27.99 Dorsal implant+bone augmentation: 39.58 No statistical significance between the groups	Moderate

	To evaluate the effect of bone graft substitutes when internal, angle stable fixation is used **Time to follow-up** 6 weeks, 3, 6 and 12 months **Performed (yrs)** Time when study was performed not stated	osseoligamentous injuries of the extremity n=39 Internal fixation (dorsal implant) mean age: 67.7 years 17 women and 3 men Bone graft men age: 67.3 years 16 women and 3 men	**Participants** n=20 **Drop-out rate** n=0 **Side effects** n=3 secondary displacement of a fragment and intraarticular steps greater than 2 mm; n=3 CRPS; n=2 tendon ruptures of the EDC II requiring operative treatment	(Chronos, Synthes Corporation) **Participants** n=19 **Drop-out rate** n=0 **Side effects** n=2 acute carpal tunnel release; n=4 secondary displacement of a fragment and intraarticular steps greater than 2 mm; n=5 CRPS; n=1 tendon ruptures of the EDC II requiring operative treatment	**The Gartland-Werley score 12 months** similar in both groups **Grip strength 12 months, expressed as percentage of the uninjured hand** Dorsal implant 75% Dorsal implant+bone augmentation 70% No statistical significance	
Kelly et al 1997 [24] United Kingdom	**Injury** Dorsally displaced distal radius fracture **Design** Randomized controlled study **Aim** Compare closed manipulation of fractures with immobilization alone	**Participants** Inclusion: >65 years; dorsally displaced distal radial fracture between 10° and 30° of dorsal angulation; less than 5 mm of radial shortening Exclusion: previous ipsilateral forearm fractures n=30 27 women and 3 men	**Manipulation under Biers block** Closed reduction of the fracture under Bier's block followed by immobilization in a dorsoradial slab applied in full ulnar deviation and 20˚ of palmar flexion completed to a forearm cast the next day. Cast removed at 5 weeks	**Plaster immobilization only** Immobilization in situ in a dorsoradial slab applied in full ulnar deviation and 20˚ of palmar flexion completed to a forearm cast the next day. Cast removed at 5 weeks **Participants** n=15	**Gartland and Werley** was used (as modified by Sarmiento), mean (range) ***3 months after removal of cast*** Group 1: 5.81 (1–12) Group 2: 6.61 (3–14) ***1 month after removal of cast*** Group 1: 9.6 (2–12) Group 2: 9.6 (7–14) **Grip strength was measured using the Jamar dynamometer (TEC, Clifton, New Jersey), percent of the value predicted. Time point not stated** Group 1: 48.8 (17%)	Moderate

	Time to follow-up 1 and 3 months **Performed (yrs)** Time when study was performed not stated	Closed reduction under Biers block mean age: 75.4 years (7.3) Immobilization mean age: 74.3 years (7.3**)**	**Participants** n=15 **Drop-out rate** n=0 **Side effects** n=1 algodystrophy n=2 finger stiffness	**Drop-out rate** n=0 **Side effects** n=1 algodystrophy; n=2 finger stiffness	Group 2: 55.6 (19%) n.s.	
Kim et al 2011 [25] South Korea	**Injury** Displaced distal radius fractures **Design** Randomized controlled study **Aim** To compare the clinical and radiological results of volar locking plate fixation with volar locking plate augmented with calcium phosphate bone cement **Time to follow-up** 3 and 12 months **Performed (yrs)** 2007–	**Participants** Inclusion Patients older than 65 years with an acute distal radial fracture that after 1 attempt at closed reduction showed unacceptable reduction: dorsal angulation of >10°, volar angu1ation of >20°, an articular gap or step-off of >2 mm, radial inclination of <10°, or radial shortening of >2 mm Exclusion: preexisting severe illness, previous wrist injury, surgical delay of more than 2 weeks, concomitant ulnar neck fracture n=48 (50 allocated) 40 female and 8 male	**Volar locking plate (Group 1)** Open reduction and fixation with volar locking plate. Below the elbow cast for 2 weeks, removable brace for another 2 weeks **Participants** n=25 (20 at 12 months) **Drop-out rate** n=5 at 12 months	**Volar locking plate fixation with injection of calcium phosphate bone cement (Group 2)** Open reduction and fixation with volar locking plate. Calcium phosphate bone cement was injected into the fracture void. Below the elbow cast for 2 weeks, removable brace for another 2 weeks. **Participants** n=25 (21 at 12 months) **Drop-out rate** n=4 at 12 months	**Disabilities of the Arm, Shoulder and Hand (DASH)** **Scores**, mean (SD) ***12 months*** Group 1: 10 (8) Group 2: 10 (7) n.s. ***3 months*** Group 1: 23 (15) Group 2: 23 (12) n.s. **Grip strength** (kg) measured with use of a Jamar dynamometer expressed as percentage of the contralateral side, mean (SD) ***12 months*** Group 1: 82% Group 2: 83% n.s. ***3 months*** Group 1: 67% Group 2: 69% n.s.	Low

		Volar locking plate fixation mean age: 74 years Volar locking plate fixation+injection of calcium phosphate bone cement mean age: 72 years			**Complications** Loss of reduction occurred in 1 wrist in each group, and both patients refused a reoperation. 1 superficial skin infections in each group responded to intravenous antibiotics	
Liu et al 2011 [26] China	**Injury** 2- and 3-part prox humerus fractures **Design** Randomized controlled study **Aim** To compare proximal humeral internal locking system (PHILOS) with or without minimally invasive injectable bone substitute (MIIG) **Time to follow-up** 12 month **Performed (yrs)** 2007–2010	**Participants** Inclusion: >60 years; T-score below 2.5;fractures due to falls Exclusion: pathological fractures; severely comminuted fractures of the humeral head of the Neer (4-part type) n=50 36 women and 14 men PHILOS mean age: 69.7 years (60–82) PHILOS+MIG: 70.4 (63–86)	**Proximal humeral Proximal Humerus Internal locking system (PHILOS)** A PHILOS plate trough a 3 cm anterolateral incision. Percutaneous reduction. Another 2 cm incision was used to attach the distal part of the plate. All patients were immobilized in wide arm slings for 2 weeks postoperatively with early active muscle contraction exercises 1 day postoperatively **Operative time** 65.8 min (12.9) **Participants** n=21	**PHILOS+minimally Minimally invasive injectable graft (MIIG)** Surgery was the same as in the PHILOS group and in addition injectable graft (MIIG) X3 Hivisc was inserted to strengthen the spongy bone and fill the bone defects. All patients were immobilized in wide arm slings for 2 weeks postoperatively with early active muscle contraction exercises 1 day postoperatively **Operative time** 70.7 min (13.1) **Participants** n=29 **Drop-out rate**	**Neer scoring system, mean (range)** ***12 months*** PHILOS: 75.5 (60.1–89.8) PHILOS+MIIG: 83.7 (62.3–92.2) p>0.05 **Complications** See side effects. Differences between groups regarding complications was statistically significant (p<0.05)	Moderate

			Drop-out rate n=0 **Side effects** n=6 (n=1 various redislocations; n=2 fixation loosening n=2 screw penetrations into the glenohumeral joint; n=1 osteonecrosis of the humeral head)	n=0 **Side effects** n=1 in PHILOS+MIIG group (osteonecrosis of the humeral head)		
Lopiz et al 2014 [27] Spain	**Injury** Proximal humerus fractures, 2- and 3-part fractures (Neer) **Design** Randomized controlled study **Aim** Comparing a straight interlocking nail and curvilinear interlocking nail design with respect to shoulder function **Time to follow-up** 12 months for Constant score	**Participants** Inclusion: 2- or 3-part proximal humerus fractures Exclusion: pathological or open fractures, 4-part fractures, concomitant fractures in upper limb, previous surgery on the ipsilateral shoulder n=52 41 women and 11 men MPHN mean age: 69 years (47–87) Curvilinear nail mean age: 71 years (38–89)	**Straight nail (MultiLoc Proximal Humeral Nail (MPHN))** Closed reduction or when needed – open reduction, percutaneous nail insertion, entry point apex of humeral head. Early passive or assisted motion **Participants** n=26 (28 allocated) **Drop-out rate** n=2 (1 expired and 1 was lost to follow-up)	**Curvilinear nail (Polarus)** Closed reduction, percutaneous nail insertion, entry point just medial to the greater tuberosity, early passive or assisted motion **Participants** n=26 **Drop-out rate** n=0	**Constant score** mean (SD) ***12 months*** MPHN: 61.2 (9.3) Polarus: 51.4 (11.5) p=0.246 **The adjusted Constant score** depending on age and sex of each patient, mean (SD) ***12 months*** MPHN: 83.3 (16.7) Polarus: 72.7 (16.0) **Complications** ***MPHN group*** n=3 hardware removal (11.5%), 2 due to sub acromial impingement, 1 proximal screw removal because of articular surface intrusion ***Polarus nail group*** n=11 patients (42%) hardware removal due to loss of fixation and/or prominent hardware, 7 due to proximal screw back-out, 4 complete hardware	

	Performed (yrs) 2011–2012				removal, 1 revision to a reverse arthroplasty at 3 weeks after surgery	
Marcheix et al 2010 [28] France	**Injury** **Distal radius fracture** **Design** Randomized controlled study **Aim** To compare radiological and clinical results of mixed pins or a palmar fixed-angle plate for treatment of dorsally displaced distal radius fractures **Time to follow-up** 3, 6, 12 and 26 weeks **Performed (yrs)** 2007–	**Participants** Inclusion: Dorsally displaced distal radius fractures in patients aged 50 years or more, intra- or extra-articular, with or without a distal ulna fracture Exclusion: palmar tilted distal radius fracture, open fractures, and patients with polytrauma n=103 (110 allocated) 86 women and 17 men K-wires mean age: 73 years (11) Palmar Plate mean age: 75 years (11)	**Mixed pinning** The fracture Closed reduction and percutaneous fixation with 4 Kirschner wires, 3 intra focal and 1 trans styloid. Below the elbow cast for 3 weeks, wires removed at 6 weeks **Participants** n=53 (56 allocated) **Drop-out rate** n=1 did not receive allocated intervention (used palmar-fixed angle plate); n=3 patients died before the first 2 appointments or failed to appear at the first consultation	**Palmar fixed-angle plating** Open reduction and fixation with volar locking plate. Below the elbow cast for 3 weeks **Participants** n=50 (54 allocated) **Drop-out rate** n=1 did not receive allocated intervention (needed rapid surgery because of anaesthetic risk); n=4 patients died before the first 2 appointments or failed to appear at the first consultation	**DASH scores,** mean (SD) ***12 weeks*** K-wires: 33 (22) Palmar plate: 25 (21) p=0.053 ***26 weeks*** K-wires 22 (22) Palmar plate 10 (14) p=0.003 **Grip strength as expressed as percentage of the contralateral side** ***12 weeks*** K-wires: 45% (25) Palmar plate: 54% (21) ***26 weeks*** K-wires: 58% (24) Palmar plate: 70% (21) **Complications** ***Complex Regional Pain Syndrome (CRPS)*** K-wire: n=5 Palmar plate: n=1 p>0.2 ***Wound infections*** K-wire: n=3 Palmar plate: n=0 p>0.2 ***Hypoaesthesia in the territory of the radial nerve*** K-wire: n=1 Palmar plate: n=0	

					Over-reduced fracture with a palmar tilt of >15˚ K-wires: n=8 Palmar plate: n=0	
McFadyen et al 2011 [29] United Kingdom	**Injury** Distal radius fractures, AO type A **Design** Randomized controlled study **Aim** Compare the functional and radiological outcomes of extra-articular distal radial fractures treated with volar locking plates or percutaneous K-wire fixation **Time to follow-up** 6 weeks, 3 and 6 months **Performed (yrs)** Time when study was performed not stated	**Participants** Inclusion: Patients with closed, unilateral, dorsally displaced, unstable extra-articular distal radius fractures (type AO type A). Instability was defined as dorsal angulation (>20˚), dorsal comminution and radial shortening (>4 mm) Exclusion Intraarticular fractures (AO type B or C), bilateral fractures, multiple injuries, radiographic evidence of pre-existing hand and wrist arthritis, dementia and open fractures n=56 33 women and 23 men Plate median age: 61 years (26–80) K-wire median age: 65 years (18–80)	**Percutaneous K-wire fixation** Closed reduction and fixation with 3 interfragmentary 1.6-mm percutaneous pins. Pins were left percutaneously. Below the elbow cast for 6 weeks **Participants** n=29 **Drop-out rate** n=0	**Volar locking plate** Open reduction and fixation with volar locking plate. Below the elbow cast for 6 weeks **Participants** n=27 **Drop-out rate** n=0	**DASH scores,** mean ***3 months*** Plate: 18.26 K-wire: 27.24 p=0.001 ***6 months*** Plate: 15.89 K-wire: 21.45 p=0.017 ***Gartland and Werley scores, mean*** ***3 months*** Plate: 17.20 K-wire: 30.28 p=0.001 ***6 months*** Plate: 16.22 K-wire: 28.03 p=0.001 **Complications** K-wire group n=8 patients (28%): pin-site infection in 5 patients (17%), superficial radial nerve palsy in 1 patient, carpal tunnel syndrome secondary to loss of fracture position in 1 patient and a painful migrated pin in 1 patient. 3 patients in the K-wire group required a second operation (re-manipulation and re-pinning of the fracture with decompression of the carpal tunnel in the patient with carpal tunnel	Low

					syndrome, retrieval of a migrated pin, corrective osteotomy for a malunion) Plate group - No specific complication was recorded	
McKee et al 2009 [30] Canada	**Injury** Distal humerus fractures, AO type 13C **Design** Randomized controlled study **Aim** To compare functional outcomes, complications, and reoperation rates in elderly patients with displaced intra-articular, distal humeral fractures treated with open reduction internal fixation (ORIF) or primary semi constrained total elbow arthroplasty (TEA) **Time to follow-up** 3, 6, 12, and 24 months	**Participants** Inclusion: women and men with an age greater than 65 years with displaced, comminuted, intra-articular fractures of the distal humerus, and closed or Gustilo grade I open fractures treated within 12 hours of injury Exklusion: extra-articular or partial articular fractures of the distal humerus, open fractures, pathologic fracture, associated vascular injury, previous ipsilateral distal humeral fracture and inter-articular fracture that did not required surgical intervention, fractures not treated within 21 days n=40 35 women and 5 men ORIF mean age: 78 years TEA mean age: 77 years	**Open reduction internal fixation (ORIF)** Open reduction and fixation with 2 plates, parallel or orthogonal. Dorsal approach without olecranon osteotomy. Resting splint and early motion **Participants** n=20 (15 at follow-up) **Drop-out rate** n=5 (to TEA group)	**Primary semiconstrained total elbow arthroplasty (TEA)** Semiconstrained TEA (Coonrad-Morrey) was performed via a posterior triceps-sparing approach with resection of condylar fragments. Resting splint and early motion **Participants** n=20 (25 at follow-up) **Drop-out rate** n=0 5 additional participants from ORIF group	**DASH scores** ***6 months*** TEA: 31 ORIF: 47 p=0.04 ***12 months*** TEA: 31 ORIF: 47 p=0.07 ***24 months*** TEA: 32 ORIF: 43 p=0.18 **Operative time** TEA: 108 minutes (+–21) ORIF: 140 minutes (+–38) **Objective elbow performance scores (MEPS)** ***6 months*** TEA: 86 ORIF: 68 p=0.003 ***12 months*** TEA 88 ORIF 72 p=0.007 ***24 months***	Low

	Performed (yrs) 2001–				TEA: 86 ORIF: 73 p=0.015 **Complications** 8 patients treated with ORIF and 10 with TEA had at least 1 complication (p=.4). 4 ORIF and 3 TEA patients had more than 1 complication. Ulnar nerve symptoms were the most common overall complication and were present in 20% of patients, including 5 treated with ORIF and 3 treated with TEA. 2 required ulnar neurolysis for persistent symptoms, 1 with ORIF and 1 with TEA. Problems with wound healing without signs of infection (delayed healing, skin edge necrosis hematoma) were encountered in 2 patients in the ORIF group and 4 in the TEA group. In 5 patients (2 in ORIF group and 3 in TEA group), posttraumatic stiffness developed, with 2 in each group undergoing reoperation, including a capsular release. 1 patient in the TEA group developed early loosening and a deep infection developed at 9 months, requiring a 2 stage revision elbow arthroplasty. 1 in the ORIF group and 3 in the TEA group developed heterotopic ossification Brooker type III Reoperation rates for TEA (3/25 [12%]) and ORIF (4/15 [27%]) were not statistically different (p=0.2)	
McQueen et al 1998 [31] Scotland	**Injury** Distal radius fractures, unstable fractures AO type A3.2, A3.3, C2.1	**Participants** Inclusion: patients with unstable fractures of the distal radius. Instability was defined as a failure to hold the reduced position of the fracture within a forearm cast, and	**Bridging external fixation** Closed re-reduction and application of a Pennig external fixator. 2 pins were inserted into the second metacarpal	**Non-bridging external fixation** Closed reduction and application of a non-bridging Pennig fixator. 2 fixator pins were inserted parallel to the surface of the	**Mass grip strength** (Jamar dynamometer, expressed as a percentage) of the normal side, mean (SD) **3 months** Bridging group: 30 (16) Non-bridging group: 54 (27) p<0.001	Moderate

	Design Randomized controlled study **Aim** Compare non-bridging with bridging external fixation in restoring the normal anatomy, carpal alignment and function of the hand **Time to follow-up** 6 weeks, 3 and 6 months, 1 year **Performed (yrs)** 1993–1995	redisplacement to dorsal angulation of more than 10° Exclusion: residual dorsal angulation after primary reduction, an interval more than 2 weeks from injury to recognition of the instability, fracture with less than 1 cm of intact volar cortex on the distal fragment, previous malunion, or patients unable, physically or mentally, to perform the functional evaluation n=60 55 women and 5 men Group 1 mean age: 61 years (13) Group 2 mean age: 62 (14)	and 2 into the shaft of the radius using the open placement technique. The fixator was locked until removal at 6 weeks **Participants** n=30 **Drop-out rate** n=2 at 1 year	joint in the distal radial fragment from the dorsal to the volar aspects and engaging the volar cortex. 2 pins were inserted into the radial shaft using an open placement technique. Fixator was removed after 6 weeks **Participants** n=30 **Drop-out rate** n=1 at 3 months n=2 at 6 months and 1 year	***6 months*** Bridging group: 50 (22) Non-bridging group 75: (21) p<0.001 ***1 year*** Bridging group: 69 (21) Non-bridging group: 87 (16) p<0.001 **Complications** ***Pin-track infection*** Bridging group: 2 Non-bridging group: 7 ***Rupture of extensor pollicis longus*** Bridging group: 0 Non-bridging group: 2 ***Reflex sympathetic dystrophy*** Bridging group: 2 Non-bridging group: 0 ***Malunion*** Bridging group: 14 Non-bridging group: 0	
McQueen et al 1996 [32] Scotland	**Injury** Distal radius fractures, unstable fractures AO type A3.2, C2.1–3, C3.2 **Design** Randomized controlled study	**Participants** Inclusion: patients with unstable fractures of the distal radius. Instability was defined as a failure to hold the reduced position of the fracture within a forearm cast, and redisplacement to dorsal angulation of more than	**Remanipulation and plaster (group 1)** closed re-reduction and below the elbow cast for 6 weeks **Participants** n=30 **Drop-out rate**	**External fixation (bridging) of the wrist at 3 weeks (group 3)** Closed re-reduction and application of a Pennig external fixator. 2 pins were inserted into the second metacarpal	**Mass grip strength** expressed as a percentage of the normal side for all groups at mean (SD 3 months, mean (SD) (no significant differences between the groups) Group 1: 24 (21) Group 2: 28 (22) Group 3: 18 (21) Group 4: 23 (25)	Low

	Aim Comparing 4 methods of treatment after redisplaced fractures of the distal radius **Time to follow-up** 6 weeks, 3 and 6 months and 1 year **Performed (yrs)** 1991–1993	10° or more than 3mm shortening Exclusion: residual dorsal angulation after primary reduction, an interval more than 2 weeks from injury to recognition of the instability, previous malunion, or patients unable physically or mentally, to perform the functional evaluation Group 1 mean age: 64 years (14.5) Group 2 mean age: 59 years (17.9) Group 3 mean age: 63 years (11.6) Group 4 mean age: 65 years (14.7) n=120 107 women and 13 men	n=3 at 3 months n=2 at 1 year (28 participants at 1 year) **Open reduction and bone grafting (group 2)** Open reduction and iliac crest bone inserted dorsally, held in place by a Kirschner wire inserted diagonally across the fracture from the radial styloid. Below the elbow cast for 6 weeks **Participants** n=30 **Drop-out rate** n=2 at 3 months n=1 at 6 months n=3 at 1 years (27 participated at 1 year)	and 2 into the shaft of the radius using the open placement technique. The fixator was locked until removal at 6 weeks **Participants** n=30 **Drop-out rate** n=1 at 3 months n=2 at 1 year (28 participants at 1 year) **Closed external fixation with mobilisation of the wrist at 3 weeks (group 4)** Same procedure as group 3 but at 3 weeks the ball joint was released to allow wrist movement. Fixator removed after 6 weeks **Participants** n=30 **Drop-out rate** n=3 at 3 months n=3 at 6 months n=4 at 1 year (26 participants at 1 year)	6 months, mean (SD) (no significant differences between the groups) Group 1: 46 (24) Group 2: 52 (32) Group 3: 53 (30) Group 4: 43 (32) 1 year, mean (SD) (no significant differences between the groups) Group 1: 68 (28) Group 2: 65 (29) Group 3: 64 (27) Group 4: 54 (32) Whole: 63 (29) **Complications** ***Malunion*** Group 1: n=20 Group 2: n=10 Group 3: n=11 Group 4: n=13 ***Carpal collapse*** Group 1: n=14 Group 2: n=11 Group 3: n=14 Group 4: n=11 ***Pin-track or K-wire infection*** Group 1: n=0 Group 2: n=1 Group 3: n=7 Group 4: n=2 ***Reflex sympathetic dystrophy*** Group 1: n=1 Group 2: n=1	

					Group 3: n=4 Group 4: n=3 ***Carpal tunnel syndrome*** Group 1: n=1 Group 2: n=2 Group 3: n=1 Group 4: n=2 ***Dorsal medial neurapraxia*** Group 1: n=0 Group 2: n=1 Group 3: n=1 Group 4: n=0 ***Wound infection*** Group 1: n=0 Group 2: n=2 Group 3: n=0 Group 4: n=0 ***Extensor pollicis longus rupture*** Group 1: n=0 Group 2: n=1 Group 3: n=0 Group 4: n=0	
Mellstrand Navarro et al 2016 [33] Sweden Data on PRWE for 3 and 1 year are also available in article	**Injury** Distal radius fractures AO-type A2, A3, Cl, C2, and C3 **Design** Randomized controlled study **Aim**	**Participants** Inclusion: women 50–74 years and men 60–74 years with distal radius fracture after fall from a standing height, diagnosed within 72 h, displacement of ≥20° dorsal angulation and/or ≥5 mm axial shortening n=140	**Fixation with a volar locking plate** Open reduction and fixation with a volar locking plate. Immobilisation in a dorsal plaster splint for 4 weeks **Participants** n=70	**External fixation** Closed reduction and bridging external fixation. Supplemental K-wires used at surgeons' discretion. Duration of fixation was 5 weeks **Participants**	**DASH scores, mean (range)** ***3 months*** Volar locking plate: 18 (0–66) External fixation: 23 (1.7–66) p=0.067 ***12 months*** Volar locking plate: 11 (0–77) External fixation: 13 (0–62) p=0.244	Low

	To compare the outcomes after open reduction and fixation with a volar locking plate or external fixation with optional addition of K-wires in patients aged 50-74 years **Time to follow-up** at 2 and 6 weeks and at 3 and 12 months **Performed (yrs)** 2009–2013	128 women and 12 men Fixation with a volar locking plate mean age 63 (50–74) years External fixation with optional addition of K-wires mean age 63 (50–74) years	**Drop-out rate** ***12 months:*** declined to participate (n=1)	n=70 **Drop-out rate** ***3 months:*** death (n=1); declined to participate (n=1) ***12 months***: declined to participate (n=1); no answer (n=1)	**Grip strength** was expressed as percentage of the uninjured side ***3 months*** Volar locking plate: 63% External fixation: 52% p=0.007 ***12 months*** Volar locking plate: 88% External fixation: 82% p=0.072 **EQ-5D, mean (range)** ***3 months*** Volar locking plate: 0.81 (0–1) External fixation: 0.77 (0–1) p=0.219 ***12 months*** Volar locking plate: 0.85 (0–1) External fixation: 0.89 (0.62–1) p=0.894 **Time for surgery** was longer for the volar plate group with a mean time in the operating room of 70 minutes compared with 42 minutes for the external fixation group (p<0.001) **Complications** Cross-over: 5 patients in external fixation group received plate fixation (failed reduction) Secondary displacement with 2nd surgery: External fixation=3 (received plate fixation)	

					Plate fixation=2 Secondary carpal tunnel release: External fixation=2 Plate fixation=1 Post-operative infection: External fixation=11 (1 deep) Plate fixation=0 7 plates were removed within 1 year (6 flexor tenosynovitis, 1 patients wish) The overall rate of complications was equal in both groups. 35 out of 69 patients in the volar locking plate group and 29 out of 65 in the external fixation group presented with 1 or more complications (p=0.346)	
Millett et al 1995 [34] United Kingdom	**Injury** **Distal radius fracture, dorsally displaced** **Design** Randomized controlled study **Aim** Investigate whether early mobilisation of the fractured wrist could influence the recovery and improve the	**Participants** Inclusion: adult women with unilateral Colles' fracture, normal forearm/hand function before injury, essentially normal contralateral forearm/hand, ability to return for follow-up Exclusion: generalized rheumatic disease, previous history of forearm/hand injury n=90 (only women)	**Plaster cast, 5 weeks** Closed reduction and immobilisation in ulnar deviation and supination in below the elbow cast for 5 weeks **Participants** n=45 **Drop-out rate** n=5 died during the study, and the remainder either moved away or were otherwise lost to 3	**Early mobilisation** Closed reduction and immobilisation in ulnar deviation and supination in below the elbow cast for 3 weeks followed by 2 weeks in a flexible Viscopaste® cast (Smith and Nephew) **Participants** n=45 **Drop-out rate** n=5 died during the study, and the remainder either	**Grip strength** calculated as the injured grip strength over non-injured, mean (SD) ***3 months*** Plaster cast 5 weeks: 0.477 (0.278) Early mobilisation: 0.603 (0.266) p<0.05 ***6 months*** Plaster cast 5 weeks: 0.638 (0.246) Early mobilisation: 0.811 (0.260) n.s. ***3 years*** Plaster cast 5 weeks: 0.941 (0.388) Early mobilisation: 0.963 (0.181) n.s.	Low

	functional outcome **Time to follow-up** at 1, 3, and 5 weeks and 3, 6 months and 3 years **Performed (yrs)** Time when study was performed not stated	Conventional plaster mean age: 61 years (22–88) Early mobilization mean age: 60 years (23–84)	years follow-up (in sum 17 dropped out)	moved away or were otherwise lost to 3 years follow-up (in sum 17 dropped out)	**Complications** At the 3 year follow-up, 1/3 of patients in both groups reported pain in the injured wrist. This was most often localized over the radioulnar joint Disability, defined as interference with the activities of daily living, was present in about 10 per cent of patients in both groups at 3 years. It was classified as mild in all cases	
Olerud et al 2011 [35] Sweden	**Injury** Proximal humerus fractures, 4-part fractures (Neer) **Design** Randomized controlled study **Aim** To compare surgical treatment with hemiarthroplasty and nonoperative treatment in patient-reported outcome after 2 years **Time to follow-up** 4, 12 and 24 months	**Participants** Inclusion: patients with an acute displaced 4-part fracture of the surgical neck of the humerus, age 55 or older, low-energy trauma, independent living conditions Exclusion: completely displaced surgical neck, valgus impaction, previous shoulder problems, severe cognitive dysfunction n=55 47 women and 8 men Hemiarthroplasty mean age: 75.8 years (58–90)	**Hemiarthroplasty (HA)** Hemiarthroplasty (Global Fx) was performed within 6 days (mean). Post-op sling for 6 weeks, early pendulum exercises **Participants** n=26 (1 additional patient operated with locking plate) **Drop-out rate** n=3 at 24 months follow-up (3 dead)	**Nonoperative treatment** Immobilisation in a sling for 2 weeks where after physiotherapy **Participants** n=28 **Drop-out rate** n=3 at 24 months follow-up (2 dead, 1 lost)	**Disabilities of the Arm, Shoulder and Hand (DASH)** *(DASH score: 0=no disability and 100=most severe disability)*, mean (SD) ***4 months*** HA: 42.8 (20.6) Nonoperative: 41.5 (19.9) p=0.92 ***12 months*** HA: 32.0 (22.6) Nonoperative: 35.0 (23.8) p=0.71 ***24 months*** HA: 30.2 (18.3) Nonoperative: 36.9 (21.3) p=0.25 **Constant score** (best possible=100 and worst possible=0), mean (SD)	Moderate

	Performed (yrs) 2003–2008	Nonoperative mean age: 77.5 years (60–92)			***4 months*** HA: 36.0 (14.6) Nonoperative: 41.4 (12.7) p=0.21 ***12 months*** HA: 48.9 (14.6) Nonoperative: 47.7 (16.8) p=0.76 ***24 months*** HA: 48.3 (16.4) Nonoperative: 49.6 (20.5) p=0.81 **EQ-5D score** ***4 months*** HA: 0.69 (0.22) Nonoperative: 0.59 (0.28) P=0.50 ***12 months*** HA: 0.73 (0.22) Nonoperative: 0.66 (0.24) P=0.26 ***2 years*** HA: 0.81 Nonoperative: 0.65 p=0.02 **Complications** ***HA group*** n=3 patients (11%) had additional surgery n=5 secondary dislocation of the greater tubercle (GT)>20 mm n=1 complete resorption of GT	

					n=2 Partial resorption of GT ***Nonoperative*** n=1 patient (4%) in the nonoperative group had additional surgery n=1 non-union n=23 Malunion n=3 Avascular necrosis n=5 Posttraumatic arthrosis	
Olerud et al 2011 [36] Sweden	**Injury** Proximal humerus fractures, 3-part fractures (Neer) **Design** Randomized controlled study **Aim** To compare surgical treatment with locking plate and nonoperative treatment in patient-reported outcome after 2 years **Time to follow-up** 4, 12 and 24 months **Performed (yrs)** 2003–2008	**Participants** Inclusion: patients with an acute displaced 3-part fracture of the surgical neck of the humerus, age 55 or older, low-energy trauma, independent living conditions Exclusion: completely displaced surgical neck, valgus impaction, previous shoulder problems, severe cognitive dysfunction n=59 48 women and 11 men Locking plate mean age: 72.9 years (56–92) Nonoperative mean age: 74.9 years (58–88)	**Locking plate** Open reduction in fixation with locking plate (Philos) within 3 days. Immediate gradual training **Participants** n=30 **Drop-out rate** n=3	**Nonoperative** Immobilisation in a sling for 2 weeks where after physiotherapy **Participants** n=29 **Drop-out rate** n=3	**Disabilities of the Arm, Shoulder and Hand (DASH)** mean (SD) ***4 months*** Locking plate: 36.2 (22.4) Nonoperative: 35.7 (20.1) p=0.85 ***12 months*** Locking plate: 29.1 (23.3) Nonoperative: 35.1 (24.2) p=0.32 ***24 months*** Locking plate: 26.4 (25.2) Nonoperative: 35.0 (26.8) p=0.19 ***Constant score*** mean (SD) ***4 months*** Locking plate: 52.3 (14.3) Nonoperative: 48.8 (16.3) p=0.48 ***12 months*** Locking plate: 61.5 (18.4) Nonoperative: 56.8 (16.8)	Low

					p=0.18 ***24 months*** Locking plate: 61.0 (19.2) Nonoperative: 58.4 (23.1) p=0.64 **EQ-5D score,** mean (SD) ***4 months*** Locking plate: 0.71 (0.27) Nonoperative: 0.61 (0.23) p=0.11 ***12 months*** Locking plate: 0.74 (0.24) Nonoperative: 0.65 (0.28) p=0.34 ***24 months*** Locking plate: 0.70 (0.34) Nonoperative: 0.59 (0.35) p=0.26 **Complications** ***Locking plate*** n=3 (10%) signs of AVN: 2 minor and 1 severe, 9 patients (30%) had additional surgery during the 2-year follow-up period (infection n=2, nonunion n=1, AVN n=1, plate removal n=5) ***Nonoperative*** n=1 patient had a nonunion Malunion: n=24 Axillary nerve palsy: n=1 Arthroscopic release of impingement: n=1 Avascular necrosis (AVN): n=2 Posttraumatic arthrosis: n=1	

Sanchez-Sotelo et al 2000 [37] Spain	**Injury** Distal radius fractures AO type A3 or C2 **Design** Randomized controlled study **Aim** To compare the outcome using Norian SRS+cast for 2 weeks with simple closed reduction and immobilisation in a cast for 6 weeks **Time to follow-up** 6 weeks, 3, 6 and 12 months (Green and O´Brien scoring system only for 1 year) **Performed (yrs)** 1998	**Participants** Inclusion: patients with a Colles' fracture AO type A3 or C2, age 50–85 years, fracture within 24 hours of presentation Exclusion: associated injuries in the upper limb or contralateral wrist, previous injuries to the fractured wrist n=110 97 women and 13 men Norian (SRS): 65.18 years (6.10) Conservative: 66.87 years (6.56)	**Remodellable bone cement (Norian skeletal repair system, SRS)** After closed reduction, hematoma and debris was removed through a dorsal incision and Norian SRS was injected to fill the defect. A below the elbow cast was used for 2 weeks **Participants** n=55 **Drop-out rate** Not stated	**Conservative treatment** Closed reduction and below the elbow cast was applied for 6 weeks. Redisplaced fractures were re-reduced (n=38) **Participants** n=55 **Drop-out rate** Not stated	***Grip strength, mean (SD)*** ***3 months*** Norian: 58.44 (6.00) Conservative: 44.09 (10.03) p<0.001 ***6 months*** Norian: 78.38 (6.28) Conservative: 71.2 (9.28) p<0.001 ***1 year*** Norian: 92.3 (4.32) Conservative: 80.3 (7.3) p<0.001 The modified **clinical scoring system of Green and O'Brien** ***Norian 1 year*** Excellent in 30 (54.5%), good in 15 (27.3%), fair in 7 (12.7%) and poor in 3 (5.5%) ***Conservative 1 year*** Excellent in 17 (30.9%), good in 13 (23.6%), fair in 13 (13.6%) and poor in 12 (21.8%) There was a significant difference between the rates of satisfactory (good and excellent) results obtained in the Norian (81.54%) and conservative (55.55%) group p=0.012 **Complications** ***Malunion*** Norian: 10 (18.2)	Low

					Control: 23 (41.8) ***Compression of the median nerve*** Norian: 2 (3.6) Control: 3 (5.4) ***Reflex sympathetic dystrophy*** Norian: 3 (5.4) Control: 4 (7.3) **Rupture of extensor pollicis longus** Norian: 2 (3.6) Control: 1 (1.8) ***Refracture*** Norian: 1 (1.8) Control: 0	
Schmalholz et al 1990 [38] Sweden	**Injury** Distal radius fractures Frykman Types l and Il **Design** Randomized controlled study **Aim** To compare the clinical and radiological results of bridging external fixation and fixation with methyl-methacrylate cement	**Participants** Inclusion: patients with unilateral extraarticular Colles' fracture (Frykman Types l and Il) that had redisplaced after 2 reductions. To be included in the study, a dorsal angle of 30° and/or an axial compression of at least 5 mm was required Exclusion: severe comminution, intraarticular fractures, combined radius and distal ulna fractures, previous fracture for the distal radius, mental disorders	**Bone cement fixation** After reduction the dorsal bone deficiency was filled with methyl-methacrylate cement through a dorsal incision. A dorsal plaster cast was applied for 2 weeks **Participants** n=23 **Drop-out rate** n=0	**External fixation** Closed reduction and bridging external fixation with a 1-bar Hoffman device. Duration co fixation was 5 weeks. **Participants** n=25 **Drop-out rate** n=0	**Range of Percentages for grip strength** ***Strength, percentage, 3 months*** Bone cement: 25–100 External fixation: 29–80 n.s. ***Strength, percentage, 6 months*** Bone cement: 57–100 External fixation: 57–100 n.s. ***Strength, percentage, 12 months*** Bone cement: 63–100 External fixation: 71–1 n.s. **Complications** ***Bone cement***	Low

	Time to follow-up 1, 2, 3, 6 and 12 months **Performed (yrs)** 1984–1985	n=48 46 women and 2 men Group 1: Median age 67 (50–75) 22 women and 1 man Group 2: Median age 66 (50–81) 24 women and 1 man			n=0 ***External fixation*** n=6 patients (24%). In 2, pin loosening required removal of the fixator earlier than calculated. Superficial pin-tract infection in 3 cases and a scar adherent to the bone in 1 required surgical treatment. 13 of the patients also found the fixator painful or uncomfortable	
Schonnemann et al 2011 [39] Denmark	**Injury** Distal radius fractures Older type 2 and 3 **Design** Prospective randomized study **Aim** To compare non-bridging external fixation with intramedullary fixation of unstable distal radial fractures **Time to follow-up** 12 weeks **Performed (yrs)**	**Participants** Participants were patients with Older type 2 and 3 (intact volar cortex of the distal fragment), age >17 years Exclusion: fractures older than 3 weeks, pregnancy, inability to understand or read Danish, open fracture greater than Gustillo 1, previous fracture in the affected distal radius, age less than 18, other injuries of the affected upper extremity, disabling conditions, and the inability to attend postoperative follow-up n=66 randomized, 61 at follow-up	**External fixation** Closed reduction, bridging Hoffmann external fixator. Mean fixation time 5 weeks **Participants** n=33 **Drop-out rate** n=3	**Internal fixation** And fixation with a Micronail interlicking nail. Mean fixation time 2 weeks **Participants** n=33 **Drop-out rate** n=2	**DASH questionnaire** 12 weeks, mean (SD) External fixation: 21.3 (16.1) Internal fixation: 22.9 (18.5) p=0.36 **Patient-rated wrist evaluation (PRWE) questionnaire** 12 weeks, mean (SD) External fixation: 29.3 (21.3) Internal fixation: 26.2 (23.8) p=0.70 **Grip strength** was measured with a Saehan Dynamometer (mean of 3 trials) at 5 weeks and at final follow-up, using a standard protocol ***Grip strength*** (kg) 12 weeks External fixation: 11.8 (5.7) Internal fixation: 16.4 (11.9) p=0.03 **Complications** ***Micronail***	Moderate

	Time when study was performed not stated	External fixation mean age: 64 (35–88) 26 women 4 men Internal fixation mean age: 61 (19–88) 25 women and 6 men			n=1 pain in the DIP and PIP joints of the second to fifth fingers, (resolved within 6 months postoperatively); n=1 CRPS (resolved within 6 months); n=1 carpal tunnel syndrome (operated on) n=2 transient numbness n=1 persistent numbness 1 year postoperatively ***External fixation*** n=6 superficial pin-site infections n=1 rupture of the extensor pollicis longus tendon n=1 transient pain around ulnar styloid n=1 transient numbness	
Sebastiá-Forcada et al 2014 [40] Spain	**Injury** Proximal humerus fractures, 3- and 4-part fractures **Design** Prospective randomized study **Aim** Compare the outcomes of reverse shoulder arthroplasty (RSA) and hemiarthroplasty (HA) for acute proximal humeral fractures **Time to follow-up** 6 weeks and at 3, 6, and 12 months,	**Participants** Inclusion: Consecutive patients aged 70 years or older with an acute proximal humeral fracture who were candidates for shoulder arthroplasty (displaced 4-part fractures, 3-part fractures dislocation, head splitting fractures) Exclusion: contraindications to surgery, prior surgery in the shoulder, associated ipsilateral upper limb fracture, neurological disorder. Patients found to have irreparable cuff tears were not excluded from the	**Reverse shoulder arthroplasty (RSA)** SMR Reverse prosthesis was used in all shoulders. The humeral component was uncemented and Tuberosities were fixed using sutures **Participants** n=31 **Drop-out rate** n=0	**Hemiarthroplasty (HA)** SMR Trauma prosthesis was implanted in all shoulders. The humeral component was uncemented and Tuberosities were fixed using sutures **Participants** n=31 **Drop-out rate** n=1 (died at 1 year)	**The Disabilities of the Arm, Shoulder, and Hand score (QuickDASH) (time for follow-up not stated)** 0–55 points at 24–49 months follow-up, mean (range) RSA: 17.5 (12–30) HA: 24.4 (13–41) p=0.001 **Constant-Murley score** (0–100 points), absolute and adjusted for age and gender, mean (range) ***Constant score*** RSA: 56.1 (24–80) HA: 40.0 (8–74) p=0.001 ***Pain*** RSA: 14.0 (10–15) HA: 8.8 (0–15) p=0.001 ***Activity*** RSA: 16.7 (10–20) HA: 12.2 (4–20)	Low

	then yearly until at least 49 months **Performed (yrs)** 2009–2011	study to avoid patent selection n=62 53 women and 9 men RSA group mean age: 74.7 (70–85) 27 women and 4 men HA group mean age: 73.3 (70–83) 25 women and 5 men			p=0.001 ***Motion*** RSA: 21.7 (4–36) HA: 14.9 (4–34) p=0.001 ***Strength*** RSA: 4.8 (0–9) HA: 2.1 (0–5) p=.001 Total adjusted (%) 79.7 (35–100) 55.8 (11–100) p=0.001 **University of California–Los Angeles score (0–35 points)** at last follow-up, mean and range RSA: 29.1 (16–34) HA: 21.1 (6–34) p=0.001 **Complications** ***HA group*** n=1 humeral fracture during stem insertion n=1 superficial infection n=1 manipulated under general anaesthesia because of postoperative stiffness with unsuccessful outcome n=6 required revision to RSA at a mean of 15.6 months (range, 11–20 months) because of severe pain and limited function due to proximal migration ***RSA group*** n=1 hematoma that resolved n=1 deep wound infection (Staphylococcus aureus) requiring a 2-stage revision to another RSA, unsuccessful functional outcome	

Strohm et al 2004 [41] Germany	**Injury** Distal radius fractures AO type A1, A3 and C1 **Design** Prospective randomized study **Aim** To compare the clinical and radiographic outcomes of 2 different modes of Kirschner wire osteosynthesis **Time to follow-up** The final follow-up examination took place at a median of 10 months (range 6–20 months) **Performed (yrs)** 1997–1998	**Participants** Consecutive patients with a Colles fracture-type A1, A3 and C1 of the distal radius n=100 treated 85 women and 15 men Kapandji group mean age: 65 (29–92) Willenegger group mean age: 65 (15–89)	**Kapandji method** 2 intrafocal Kirschner wires are inserted into the fracture gap and a third is placed through the styloid process. Volar splint is worn for 3 weeks. **Participants** n=40 **Drop-out rate** n=17 could not be reached n=2 died (not stated in which group)	**Willenegger method** 2 interfragmentary Kirschner wires are introduced into the styloid process of the radius and fixed in the opposite cortex. Below the elbow cast for 6 weeks **Participants** n=41 **Drop-out rate** n=17 could not be reached n=2 died (not stated in which group)	**Complications at 10 months** ***Nerve irritation*** Kapandji: 5 Willenegger: 7 ***Signs of swelling*** Kapandji: 2 Willenegger: 1 ***Wire migration*** Kapandji: 3 Willenegger: 5 ***Conversion procedure*** Kapandji: 0 Willenegger: 2 ***Reflex sympathetic dystrophy*** Kapandji: 1 Willenegger: 1 ***Carpal tunnel syndrome*** Kapandji: 1 Willenegger: 1	Low
Tanaka et al 2016 [42] Japan	**Injury** Distal radius fractures AO-type A2, A3, B, C **Design**	**Participants** Inclusion: patients over 20 years with a displaced distal radius fracture, of type 23-A.2, A.3, B or C. Fracture regarded as displaced if radial inclination <15°, volar or	**Distal placement (AcuLocTM)** Open reduction and fixation with a volar plate placed distal to the watershed line (AcuLoc, Acumed)	**Proximal placement (VariAxTM)** Open reduction and fixation with a volar plate placed proximal to the watershed line (Variax, Stryker).	The Mayo Wrist Score and the DASH score demonstrated that internal fixation using both plates provided satisfactory outcomes of wrist function at the 6-month follow-up with no significant differences between groups **Mayo Wrist Score, mean** ***6 month***	Low

	Prospective randomized study **Aim** To compare clinical and radiological outcomes of fixation using locking plates placed distal or proximal to the watershed line **Time to follow-up** 6 months **Performed (yrs)** 2011–2013	dorsal tilt >15°, ulnar variance >3mm Exclusion: open fracture, fractures of the distal ulna, previous disorders in the upper extremities, brain or cervical spine, based on their self-reported medical histories n=72 (randomized) n=64 (analysed) 49 women and 15 men Distal-type: 62.9 (14.2) years Proximal-type: 61.5 (13.9)	plate. Postoperative early mobilisation **Participants** n=32 (analysed) **Drop-out rate** n=4	Postoperative early mobilisation **Participants** n=32 (analysed) **Drop-out rate** n=4	Distal-type: 90.6 points Proximal-type: 89.7 points p=0.62 **DASH score, mean** ***6 month*** Distal-type: 14.9 points Proximal-type: 12.8 points p=0.37 **Grip strength (%)** ***6 month*** Distal-type: 88.2 (25.4) Proximal-type: 87.6 (20.3) p=0.92 **Complications** Distal-type: 2 n=1 EPL rupture n=1 CRPS Proximal-type: 1 N=1 CRPS	
Tumia et al 2003 [43] Scotland	**Injury** Distal radius fractures, Colles' **Design** Prospective multicentre randomized study **Aim** Compare the outcome of the management of	**Participants** Inclusion: Patients over 18 years of age with a unilateral Colles' fracture Exclusion: previous fractures of the forearm, non-fused radial epiphysis A total of 339 patients were treated by either a conventional Colles' plaster cast or with a	**Prefabricated functional brace (the Aberdeen Colles' fracture brace)** The Aberdeen Colles' fracture brace (Smith & Nephew Ltd, Hull, UK) is a 2 piece plastic brace with Velcro straps. The brace allows wrist motion	**Conventional Colles' plaster cast** Conventional immobilisation in a molded dorsoradial splint, which was converted to a full cast at 7–10 days after a routine radiological check **Participants** n=170	**Modified Gartland and Werley scoring system** at 12–24 weeks, mean, mean difference (MD) and (CI) ***Non-manipulated group, 12 weeks*** Plaster cast: 4.8 Brace: 3.8 MD=0.9 (–0.5; 2.3) p=0.22 ***Non-manipulated group, 24 weeks*** Plaster cast: 2.6 Brace: 2.7 MD=–0.2 (–1.3; 0.9)	Moderate

	Colles' fractures using a functional fracture brace with that obtained with a conventional plaster cast **Time to follow-up** 8,12 and 24 weeks **Performed (yrs)** 1997–	prefabricated functional brace (the Aberdeen Colles' fracture brace) Fractures displaced >4mm radial angle, >3mm shortening, dorsal angulation beyond neutral were manipulated before immobilization (188 patients) 271 women and 68 men Brace group: 60.4 years (18–98) Control group: 58.4 years (19–88)	**Participants** n=169 **Drop-out rate** n=3	**Drop-out rate** n=7	p=0.7 ***Manipulated group, 12 weeks*** Plaster cast: 9.2 Brace: 7.8 MD=1.0 (–0.7; 2.6) p=0.26 ***Manipulated group, 24 weeks*** Plaster cast: 5.4 Brace: 5.8 MD=–0.7 (–2.1; 0.8) p=0.36 **The mean grip strength** as a percentage of that of the uninjured hand with an electronic dynamometer at 12 and 24 weeks, percentages, mean difference (CI) ***Non-manipulated group, 12 weeks*** Plaster cast: 72 Brace: 75 MD=3.0 (–5; 11) p=0.44 ***Non-manipulated group, 24 weeks*** Plaster cast: 87 Brace: 82 MD=–0.2 (–1.3; 0.9) p=0.3 ***Manipulated group, 12 weeks*** Plaster cast: 55 Brace: 57 MD=1 (–5; 8) p=0.64 ***Manipulated group, 24 weeks***	

					Plaster cast: 72 Brace: 72 MD=0 (–6; 6) p=1.0	
Vang Hansen et al 1998 [44] Denmark	**Injury** Distal radius fractures, Older type 1 or 2 **Design** Prospective randomized study **Aim** Compare 3 and 5 weeks of immobilization for Older type 1 and 2 Colles fractures **Time to follow-up** 1 year **Performed (yrs)** 1992–1994	**Participants** Inclusion: patients over the age of 18 with Older type 1 or 2 Colles' fracture Exclusion: hemiplegia, pathological fractures, senile dementia and patients not belonging to the hospital area n=100 randomized, 73 at follow-up 57 women and 16 men at follow-up Immobilisation 3 week mean age: 61 (18–96) years 30 women and 7 men Immobilization 5 weeks mean age: 60 (20–82) years 27 women and 9 men	**3 weeks Immobilisation** Closed reduction when necessary and immobilisation in a below the elbow cast for 3 weeks Fractures that redislocated within 10 days underwent surgery and were excluded from the study **Participants** n=50 (37 analysed) **Drop-out rate** n=13	**5 weeks Immobilisation** Closed reduction when necessary and immobilisation in a below the elbow cast for 3 weeks Fractures that redislocated within 10 days underwent surgery and were excluded from the study **Participants** n=50 (37 analysed) **Drop-out rate** n=14	**Grip strength** % of uninjured side, 1 year 3 weeks: 83% 5 weeks: 90% n.s. **Complications** Spontaneous rupture of the extensor pollicis longus 3 weeks: 1 5 weeks: 1	Moderate
Voigt et al 2011 [45] Germany	**Injury** Proximal humerus, displaced 3- and 4-part fractures (Neer)	**Participants** Inclusion: patients older than 60 years with isolated displaced 3 and 4-part fractures	**Polyaxial locking screw plate (PLSP)** Standard plating technique using polyaxial screw	**Locking screw plate (LSP)** Standard plating technique using fixed angle plate (Philos plate)	**DASH score** 1 year, mean (SD) PLSP: 17.8 (16.2) LSP 15.7 (11.8) p=0.947 **The Simple Shoulder Test**	Low

	Design Prospective randomized study **Aim** Evaluate the results of plate osteosynthesis using either polyxial or fixed angle screws in the elderly **Time to follow-up** 12 months for DASH **Performed (yrs)** Time when study was performed not stated	Exclusion: open fractures, pathological fractures, re-fractures, fractures >2 weeks, neurological disease, non-compliancy n=56 randomized No information on gender Polyaxial locking screw plate median age: 75.5 (60–80) Locking screw plate median age: 72 (60–87)	placement (Arhtrex HSP) **Participants** n=20 **Drop-out rate** n=5	**Participants** n=28 **Drop-out rate** n=3	**Assessment of shoulder function** according to **Constant Score (CS)** 3 months, mean (SD) PLSP: 5.8 (3.0) LSP: 6.9 (2.2) p=0.219 **The Simple Shoulder Test** **Assessment of shoulder function** according to **Constant Score (CS)** 6 months, mean (SD) PLSP: 7.4 (2.9) LSP: 8.0 (2.6) p=0.353 **The Simple Shoulder Test** **Assessment of shoulder function according to Constant Score (CS)** 1 year, mean (SD) PLSP: 8.6 (3.2) LSP: 9.7 (1.8) p=0.027 **Strength showed no significant difference between 6 and 12 months** **Complications at 1 year** ***Primary implant malposition*** PLSP: 0 LSP: 1 ***Secondary loss of reduction and screw perforation*** PLSP: 6 LSP: 7 ***Varus deformity*** PLSP:1 LSP:4 ***Greater tuberosity displacement***	

					PLSP:2 LSP:1 ***Avascular head necrosis (partial)*** PLSP:3 LSP:2	
Wong et al 2010 [46] China	**Injury** Dorsally displaced distal radius fractures **Design** Prospective randomized study **Aim** Compare the functional and radiological outcomes and quality of life between patients treated by immobilisation in a cast alone or percutaneous pinning alone for unstable, extra-articular fractures of the distal radius after closed reduction **Time to follow-up** 12 months (for the data presented)	**Participants** Inclusion: patients >65 years. Unstable (dorsal angulation more than 20˚ and radial shortening more than 5mm), dorsally angulated, extra-articular fracture of the distal radius Exclusion: intra-articular involvement compound fractures, concomitant fractures elsewhere, palmar angulated fractures, minimally displaced fractures or fractures with dorsal tilting less than 20˚, fractures more than 2 weeks old, dementia or psychiatric illness n=62 randomized 60 at follow-up 49 women and 11 men Mean age: 70.5 years old (65–76)	**Cast group** Closed reduction, below the elbow cast for 6 weeks **Participants**: n=30 at follow-up **Drop-out rate** n=2 dead of heart disease (not stated in which group)	**K-wire group** Closed reduction, percuteous fixation with 3 interfragmentary K-wires, below the elbow cast for 6 weeks **Participants**: n=30 at follow-up **Drop-out rate** n=2 dead of heart disease (not stated in which group)	**Mayo wrist score**, at 1 year, mean (SD) ***Pain (25 points)*** Cast: 21.8 (3.4) K-wire 20.5 (3.2) p=0.873 ***Functional status (25 points)*** Cast 23.5 (6.1) K-wire 23.1 (7.1) p=0.914 ***Range of motion (25 points)*** Cast 18.2 (4.2) K-wire 20.1 (6.3) p=0.455 ***Grip strength (25 points)*** Cast 15.3 (6.2) K-wire 14.2 (4.5) p=0.765 ***Total score (100 points)*** Cast 80.5 (7.5) K-wire 82.2 (6.2) p=0.563 **World Health Organization Quality of Life (WHOQoL) questionnaire** at 1 year, mean (SD)	Low

	Performed (yrs) July 2006–July 2007	Cast mean age: 71 (65–76) 25 women and 5 men K-wire mean age: 70 (66–76) 24 women and 6 men			***Overall scores*** Cast 3.5 (0.5) K-wire 3.7 (0.7) p=0.855 ***Physiological*** Cast 14.1 (2.1) K-wire 15.5 (1.9) p=0.663 ***Psychological*** Cast 14.5 (3.2) K-wire 15.5 (3.4) p=0.679 ***Social*** Cast 16.2 (6.7) K-wire 15.2 (5.4) p=0.327 ***Environment*** Cast 14.3 (1.8) K-wire 14.5 (2.3) p=0.546 ***Satisfaction score*** Cast 2.3 (0.4) K-wire 2.4 (0.3) p=0.895 **Complications** ***K-wire group*** n=1 pin track infection at around 4 weeks after treatment, n=1 K-wire was removed. There were no tendon nerve or vessel injuries. There were no complications associated with the palmar K-wire	

					Cast group n=1 complex regional pain syndrome and presented with pain and very stiff joint 3 months after treatment	
Zhang et al 2011 [47] China	**Injury** Proximal humerus fractures, 2-, 3- and 4-part **Design** Prospective randomized design **Aim** In fractures fixed with a plate: to evaluate the clinical benefit of medial support screws **Time to follow-up** 4, 8 and 12 weeks, 6, 9 and 12 months (data only presented for 1 year) **Performed (yrs)** 2007–2008	**Participants** Inclusion: patients older than 18 years, closed proximal humerus fracture that met the local criteria for plate fixation Exclusion: pathological fractures n=72 randomized 46 women and 26 men Mean age: 63.2 years old (32–78) +MSS mean age: 62.9 (9.6) 19 women and 10 men -MSS mean age: 63.5 (8.4)	**Locking plate+MSS** Standard plating technique (Philos plate). 1 or 2 screws into the medio-inferior region of the humeral head (calcar screws) were added through the plate **Participants** n=29 **Drop-out rate** n=4 (not available for follow-up) not stated in which group	**Locking plate–MSS (medial support screw)** Standard plating technique (Philos plate). The inferio-medial screws (calcar screws) were omitted **Participants** n=39 **Drop-out rate** n=4 (not available for follow-up) not stated in which group	**The Constant shoulder score at final follow-**: mean (SD and range) +MSS group 79.1 (13.1) (range 46–96) −MSS group 70.1(14.5) (range 41–94) p=0.01 The respective excellent and good rates of 79% and 62% **Complications** ***Distribution of early failure*** +MSS: 1 –MSS: 9 ***Total complications*** n=11 several complications (16.2%) n=1 developed asymptomatic osteonecrosis of the humeral head but did not require revision n=10 early loss of fixation n=6 varus collapse n=3 screw penetration n=1 plate breakage occurred in 1 patient Failure rate: +MSS 3.4% –MSS 23.1% in −MSS p=0.036 Early loss of fixation was related to patients of greater age (70.3±5.3 vs 60.3±6.4 years, p<0.001)	Low

Zimmermann et al 2003 [48] Austria	**Injury** Distal radius fractures AO:23-C2 and 23-C3 **Design** Prospective randomized study **Aim** To compare percutaneous pin fixation with a similar construct reinforced with Norian Skeletal Repair System (SRS) **Time to follow-up** 2 years **Performed (yrs)** 1997–1999	**Participants** Inclusion: menopausal women with Radiologically demonstrated osteoporosis, unstable intra-articular distal radius fracture with a metaphyseal compression void of at least 5 mm and lacking cortical support (AO:23-C2 and 23-C3 Exclusion: associated injuries in the upper limbs, previous wrist fractures n=52 SRS group mean age: 63 (53–73) years Percutaneous pinning mean age: 57 (49–72) years	**Injectable calcium phosphate bone cement Norian SRS** Closed reduction, percuteous pin and screw fixation, filling the defect with Norian SRS, below the elbow cast for 3 weeks **Participants** n=26 **Drop-out rate** n=0	**Percutaneous pinning** Closed reduction, percutaneous pinning and below the elbow cast for 6 weeks **Participants** n=26 **Drop-out rate** n=0	**DASH** ***Average function/symptom score 2 years***, mean (range) SRS: 10 (0–35) Control: 20 (5–60) p<0.001 ***Average music/sport/work score at 2 years***, mean (range) SRS: 9 (0–16) Control: 24 (3–55) p<0.001 ***Grip strength compared with contralateral side*** SRS 90% vs Control 73% (*p*<0.001) **Complications** ***Norian SRS*** n=1 Reflex sympathetic dystrophy n=1 Rupture flexor pollicis longus tendon ***Percutaneous pinning*** n=3 Reflex sympathetic dystrophy	Moderate
Zyto et al 1997 [49] Sweden	**Injury** Proximal humerus, displaced 3- and 4-part fractures (Neer) **Design** Prospective randomized study **Aim**	**Participants** Inclusion: 3- and 4-part fractures, at least 30% contact between the humeral head and the shaft, “elderly” patients Exclusion: high energy trauma, pathological fractures, concomitant injuries, inability to co-operate	**Tension-band wiring (TBW)** Tension-band fixation performed within 48 hours. 1 or 2 cerclage wires, with or without K-wire. The injured arm was supported in a sling for 7–10 days, followed by physiotherapy	**Non-operative treatment** The fracture was not manipulated. The injured arm was supported in a sling for 7–10 days, followed by physiotherapy according to a standard regimen	**Constant and Murley shoulder score** (no significant difference between the groups, p-values not presented in article) at 50 months, mean (SD) TBW: 60 (19) Non-op: 65 (15) n.s. ***Pain (15p)*** TBW: 10 (5) Non-op: 12 (3) n.s.	Low

	To compare tension-band osteosynthesis with non-operative treatment in the elderly patients using functional and radiological assessment **Time to follow-up** Data presented for 50 months **Performed (yrs)** Time when study was performed not stated 1990-1993	n=29 at last follow-up (40 randomized) 35 women and 5 men Mean age: 74 years old Fixation mean age: 73 (7.5) 18 women and 2 men Sling mean age: 75 (6.7) 17 women and 3 men	**Participants** n=19 (12 months) 14 (50 months) **Drop-out rate** n=1 at 1-year follow-up n=5 at final follow-up (unrelated death or unable to contact)	(same as intervention group) **Participants** n=19 (12 months) 15 (50 months) **Drop-out rate** n=1 at 1–year follow-up n=4 at final follow-up (unrelated death or unable to contact, 1 had replacement of the humeral head after another fall)	***Range of motion (40p)*** TBW: 26 (4) Non-op: 29 (3) n.s. ***Power (25p)*** TBW: 8 (5) Non-op: 8 (5) n.s. ***Activities of daily living (20p)*** TBW: 16 (5) Non-op: 16 (4) n.s. **Complications** ***TBW*** n=6: 2 infection,1 K-wire penetration, 1 pulmonary embolus, 1 nonunion, 1 osteoarthritis ***Non-op*** n=2 osteoarthritis	

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