

Review Article

Surgical versus conservative treatment for displaced proximal humeral fractures in elderly patients: a meta-analysis

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Abstract: Purpose: Treatment strategies for complex displaced proximal humeral fractures (DPHF) in elderly patients remain controversial. This meta-analysis was performed to compare the benefits and risks of surgical or conservative methods for these patients. Methods: Pubmed, Cochrane library and EMBASE were systematically searched for randomized controlled trials (RCTs) from their establishment to June 2013. Researches on surgical/conservative treatment for complex displaced proximal humeral fractures in elderly patients were selected. Methodological quality of included studies was evaluated by the Physiotherapy Evidence Database (PEDro) scale. Outcome measurements were Constant score, DASH (disabilities of the arm, shoulder and hand), postoperative complications and quality of life (QoL). The meta-analysis was performed with software Stata 12.0. Results: Six RCTs with 272 patients were included and analyzed. Six studies with a PEDro score of 6 or more were of high quality. The differences in QoL (WMD 0.43, 95% CI (0.12, 0.74)) and postoperative complications (RR 2.06, 95% CI (1.45, 2.93)) were statistically significant between operative and conservative treatment. There was no statistically significant difference in Constant score (WMD 0.06, 95% CI (-0.20, 0.31)) and DASH (WMD 0.33, 95% CI (-0.70, 0.04)). Conclusion: Despite the small improvement of QoL, surgical treatments did not significantly improve the functional outcome including Constant score and DASH. Instead, surgical treatment for displaced proximal humeral fractures in elderly patients led to higher incidence of postoperative complications.

Keywords: Surgical procedures, conservative, proximal humeral fracture, elderly, meta-analysis

Introduction

Proximal humeral fractures, with the incidence of $63.0/10^5$ per year, account for about 5.7% of all adult fractures [1]. The incidence increased with age and females are more likely to suffer proximal humeral fractures. Nearly 85% proximal humeral fractures are minimally displaced or even undisplaced [2] and can be treated conservatively. A variety of options including surgical and conservative treatments are alternative for remaining 15% displaced fractures. Some surgeons advocated that surgical intervention should be adopted to gain stability of fracture fragments [3], better radiographic outcomes and early mobilization. However, another study [4] suggested that no differences in Constant-Murley and Simple Shoulder Test scores were detected between surgical and

conservative groups, and abduction strength was even better in conservative group. Furthermore, the patients with surgical treatment suffered more complications postoperatively [5].

To solve this knotty problem, we performed a meta-analysis to explore the efficiency and complications of surgical or conservative interventions for the management of displaced proximal humeral fractures in elderly patients.

Methods

Eligibility criteria

Studies were selected according to the following criteria: (1) elderly patients with displaced proximal humeral fractures, including three-

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Table 1. General characteristics of included studies

Study	Location	Cases		Gender		Age		Participants	Intervention		Follow-up (yrs)	Outcome
		a	b	c	d	a	b		a	b		
Fjalestad 2012	Norway	25	25	44	6	72.2 (60-86)	73.1 (60-88)	displaced three- or four-part proximal humeral fractures	ORIF with angular stable plate	immobilized in bandage	1	Constant score, complications, quality of life
Boons 2012	Netherlands	24	23	47	3	76.4±5.6	79.9±7.7	displaced four-part proximal humeral fractures	Hemiarthroplasty	shoulder immobilizer for 6 weeks	1	Constant-Murley score, complications
Olerud H 2011	Sweden	27	28	47	8	75.8 (58-90)	77.5 (60-92)	displaced four-part proximal humeral fractures	Hemiarthroplasty	sling and physiotherapy	2	Constant score, DASH, complications, quality of life
Olerud P 2011	Sweden	30	29	48	11	72.9 (56-92)	74.9 (58-88)	acute displaced three-part proximal humeral fractures	ORIF with a locking plate	sling and physiotherapy	2	Constant score, DASH, complications, quality of life
Zyto 1997	Sweden	14	15	35	5	73±7.5	75±6.7	displaced three- or four-part proximal humeral fractures	Osteosynthesis	sling and physiotherapy	3	Constant score, complications
Stableforth 1984	England	16	16	25	7	65.6 (52-88)	70.1 (60-85)	four-part proximal humeral fractures	Hemiarthroplasty	sling and physiotherapy	1.5-12	Complications

a. Surgical; b. Conservative; c. Female; d. Male; yrs years.

Table 2. PEDro score of included studies

Study	PEDro Criteria ^a											Total
	1	2	3	4	5	6	7	8	9	10	11	
Fjalestad 2012	+	+	+	+	-	-	+	+	+	+	+	8
Boons 2012	+	+	+	+	-	-	-	+	-	+	+	6
Olerud H 2011	+	+	+	+	-	-	+	+	+	+	+	8
Olerud P 2011	+	+	+	+	-	-	+	+	+	+	+	8
Zyto 1997	+	+	+	+	-	-	+	-	-	+	+	6
Stableforth 1984	-	+	-	+	-	-	-	+	-	+	+	5

Abbreviations: PEDro, Physiotherapy Evidence Database scale; ^aPEDro criteria: 1. Eligibility criteria; 2. Random allocation; 3. Concealed allocation; 4. Baseline comparability; 5. Participant blinding; 6. Therapist blinding; 7. Assessor blinding; 8. 85% follow-up; 9. Intention-to-treat analysis; 10. Between-groups statistical comparison for at least 1 key outcome; 11. Point estimates and variability measures for at least 1 key outcome.

and four-part fractures; (2) surgical (open reduction internal fixation (ORIF), osteosynthesis, hemiarthroplasty, et al.) and conservative methods were compared; (3) functional outcomes (Constant score and DASH), postoperative complications or quality of life (QoL) were described; (4) study design was RCTs or quasi-RCTs; (5) published language was not restricted.

Search strategy

A systematic search of PubMed, Cochrane Library and EMBASE up to June 2013 was performed by two independent authors for studies comparing surgical and conservative treatment for displaced proximal humeral fractures in elderly patients. The search terms used were: "three-part", "four-part", "displaced", "proximal humeral fracture", "elderly", "surgical", "non-surgical", "operative", "nonoperative", "conservative" singly or in combination. The reference lists of related studies were also checked for eligible studies.

Data extraction

The eligible studies were strictly reviewed and relevant data were extracted by two authors independently. Then data were exchanged to verify and dispute was resolved by a third researcher. The extracted data included general demographic characteristics (first author, published year, location, cases, gender, age, participants, intervention, follow-up and outcomes), functional outcomes (Constant score and DASH), postoperative complications and QoL.

Methodological assessment

The methodological assessment of all RCTs was independently performed by two authors with the Physiotherapy Evidence Database (PEDro) scale [6] respectively. The 11-item PEDro scale [7] gains a maximum score of 10 (criteria one was not scored). Studies with 6 scores or higher were identified as high quality.

Statistical analysis

The primary outcomes were Constant score, DASH, complications and QoL. The secondary outcome measurements were a sensitive analysis by excluding one study at a time. All outcomes were calculated in an intention-to-treat (ITT) manner. Statistical analysis was conducted by Stata (version 12.0). Continuous variables and dichotomous data were analyzed with relative risk (RR) and standard mean difference (SMD), both with 95% confidence interval (CI) respectively. Statistical heterogeneity was assessed by the I^2 statistics. Fixed-effects model was used when the heterogeneity was negligible ($I^2 < 50\%$). Otherwise a random-effects model was adopted. Subgroup analysis was conducted by different surgical interventions, including osteosynthesis, ORIF, hemiarthroplasty. Publication bias was identified by funnel plot graphically and the Egger's test statistically. The statistical difference was considered significant at $P < 0.05$.

Results

Identification of relevant literature

A total of 332 research articles were retrieved. Among the potential studies, one study [8] was from the reference list and the rest are from database search. After excluded the duplicated studies, 202 studies were excluded. Finally, six RCTs [4, 8, 12] with 272 patients were included in this meta-analysis. The general characteristics of the six included studies are showed in **Table 1**. All studies were performed in European. Surgical interventions were performed in 136 patients while the rest 136 patients are treated conservatively. The follow up time was from 1 to 12 years.

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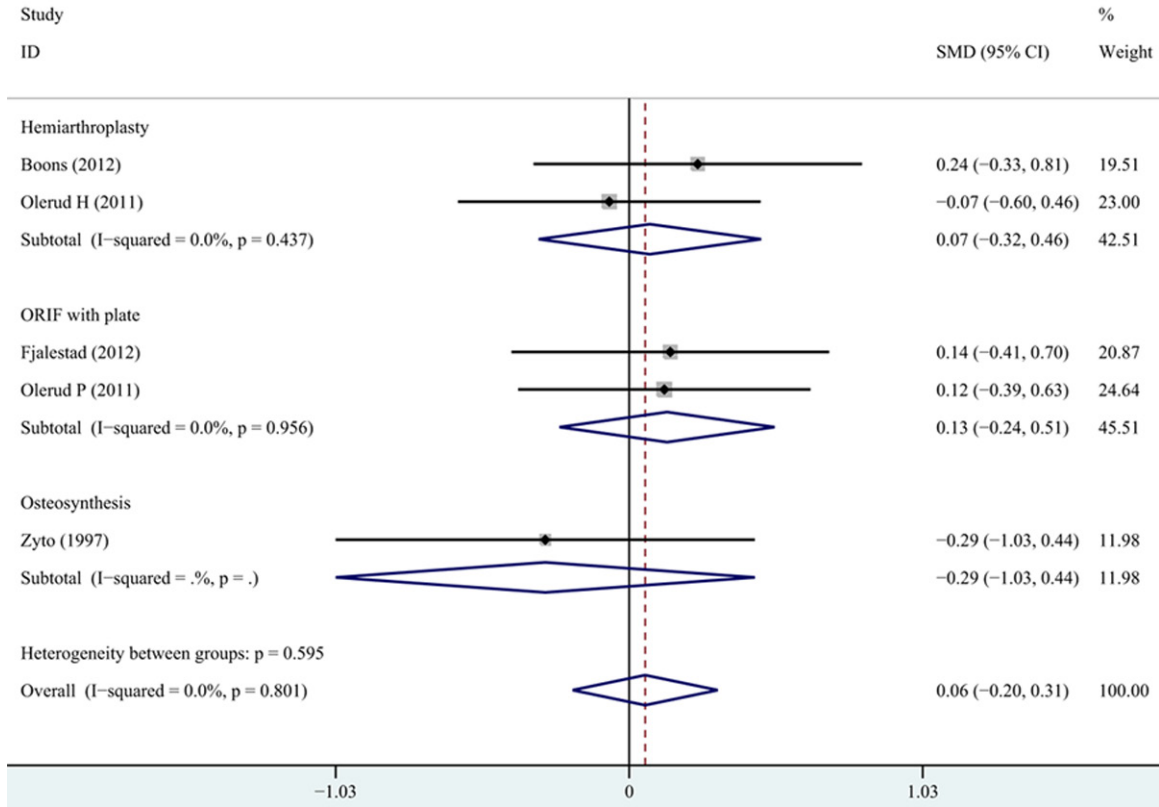


Figure 1. Forest plot for Constant score.

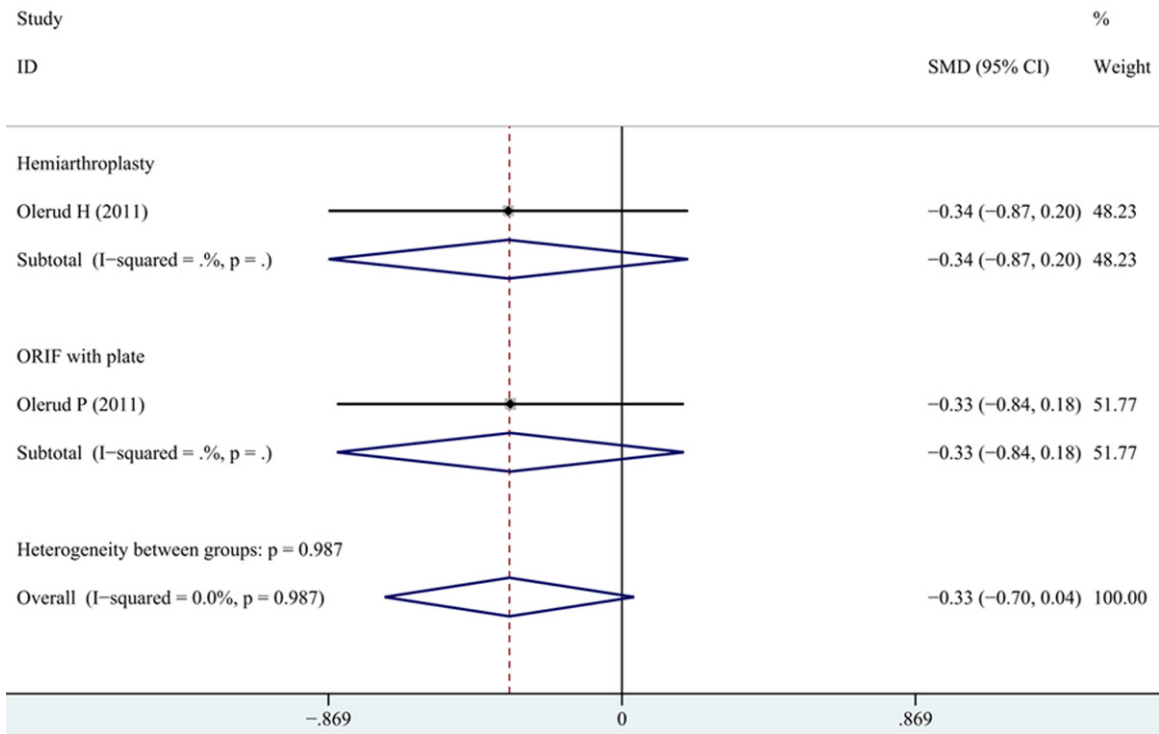


Figure 2. Forest plot for DASH.

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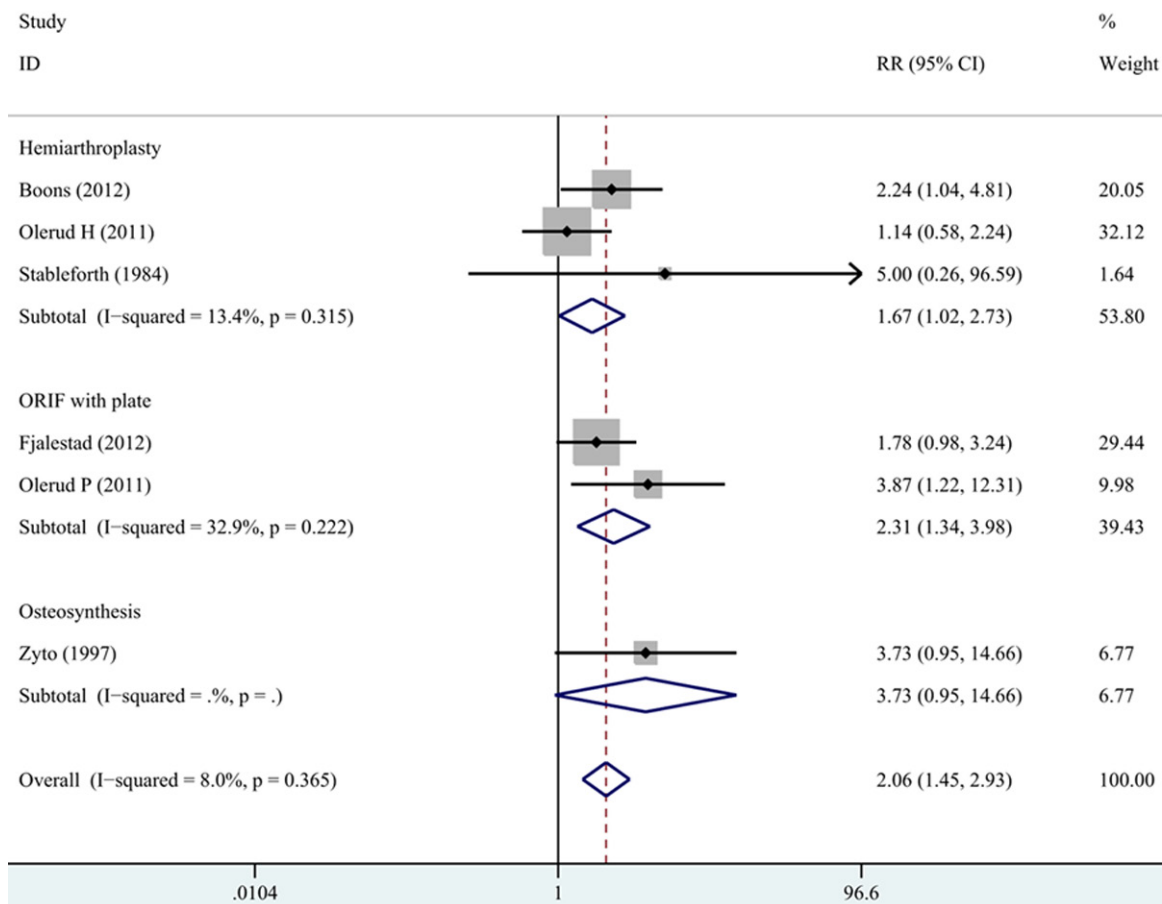


Figure 3. Forest plot for complications.

Quality assessment

The PEDro scale was used to assess the study quality and the scores of included studies were showed in **Table 2**. Of the six RCTs, five studies with 6 scores or over are of high quality and one 5-score study is of low quality. The baseline data of all studies was comparable. Randomization was mentioned in all included studies. The randomized method was described as sealed envelope in five studies while it was unclear in one study. For ethical issue only assessor blind method was described in four studies. Only 72.5% (29/40) follow-up was achieved in one study. Intention-to-treat analysis was used in three studies.

Outcome measurements

For elderly patients with displaced proximal humeral fractures, Constant score and DASH were the most commonly used to assess functional outcome. Constant score and DASH were mentioned in five studies and two studies

respectively. The results showed that no statistical significance was detected with respect to Constant score (SMD 0.06, 95% CI (-0.20, 0.31)) (**Figure 1**) and DASH (SMD -0.33, 95% CI (-0.70, 0.04)) (**Figure 2**). Complications were described in all studies and elderly patients with conservative treatment were less likely to suffer postoperative complications (RR 2.06, 95% CI (1.45, 2.93)) (**Figure 3**) during the follow-up. Various complications were summarized in **Table 3**. All described deaths were unrelated to the intervention, thus they were not considered as postoperative complications and were not included in the table. Three studies compared the QoL of patients after treated by surgical or conservative methods. The results showed that patients with surgical treatment gained better QoL (SMD 0.43, 95% CI (0.12, 0.74)) (**Figure 4**).

Subgroup analysis

Subgroup analysis was performed based on different surgical treatments. The results sho-

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Table 3. Treatment-related complications

Complication (n)	No. of Studies	Surgical		Conservative		p value
		Events (total)	%	Events (total)	%	
Nonunion	5	4 (120)	3.3	7 (120)	5.8	0.354
Avascular necrosis	5	6 (120)	5.0	5 (120)	4.2	0.758
Implant penetration	4	10 (96)	10.4	0 (97)	0	0.001
Redisplacement	3	16 (76)	21.0	3 (76)	3.9	0.002
Osteoarthritis	3	3 (71)	4.2	7 (72)	9.7	0.198
Impingement and stiffness	2	5 (54)	9.2	1 (52)	1.9	0.206
Bone resorption	2	5 (51)	9.8	0 (51)	0	0.056
Infection	2	4 (44)	9.1	0 (44)	0	0.116
Axillary nerve lesions	1	7 (25)	28.0	6 (25)	24	0.747
Pain and impairment	1	0 (24)	0	1 (23)	4.3	1.00
Haematomata	1	2 (16)	12.5	0 (16)	0	0.484
Pulmonary embolism	1	1 (14)	7.1	0 (15)	0	0.483

wed that different surgical methods achieved similar outcome and did not affect the final outcome.

Funnel plot

Published bias was assessed with funnel plot graphically and Egger's test statistically. All funnel plots were symmetrical approximately (Figure not shown). It indicated that there was no significant publication bias. Egger's test also confirmed that no publication bias existed (Data not shown).

Sensitivity analysis

All studies were excluded one by one to perform sensitivity analysis (Figure 5). No substantial change was detected with respect to Constant score, DASH, complications and QoL. It suggested that our meta-analysis is stable and reliable though the sample size is relative small.

Discussion

The results of this meta-analysis indicated surgical intervention improved the quality of life postoperatively but suffered more surgery-related complications. However, no obvious difference was observed with respect to Constant score and DASH.

According to Neer's classification, one-part and minimal displaced two-part fractures are generally treated conservatively and it gains good prognosis [13]. For the treatment of three- and four-part fractures, whether surgical or conser-

vative method is controversial. Thus, only three- and four-part fractures were included. There are several kinds of surgical methods for patients with displaced proximal humeral fractures, including ORIF, osteosynthesis, hemiarthroplasty, and so on [14]. In this study, we compared the efficiency and safety of surgical and conservative interventions for displaced proximal humeral fractures in elderly patients. Therefore, we included all RCTs comparing different kinds of surgical methods with conservative intervention. To minimize the bias of clinical heterogeneity, we performed subgroup analysis by different surgical methods. Subgroup analysis of all four outcomes demonstrated that different surgical methods gained similar results compared to conservative treatment.

In this study, two issues of general characteristics deserved to be noted. Firstly, average age of patients in all included studies was over 65 years. Secondly, there were 246 female patients and 40 male patients. Both issues were in accordance with an epidemiological study performed by Charles et al [15]. Proximal humeral fractures tended to occur in the elderly independent patient and the female was in the majority (73%). The results could be explained with postmenopausal or senile osteoporosis.

The Constant score is a widely accepted functional score of shoulder joint in the world especially in European countries [16]. With a maximum score of 100 points, 35 points of Constant score are available for pain and activities of daily living while 65 points are allocated for range of movement and shoulder strength. No statistical difference was detected with respect to Constant score in our meta-analysis. The DASH questionnaire, consists of a 30-item disability/symptom scale with maximum 100 points, is a measurement of upper-extremity disability and symptoms [17]. There was also no statistical difference with regard to DASH between two groups in our findings. Chris et al [18] collected Constant-Murley score and VAS score (pain) of displaced proximal humeral frac-

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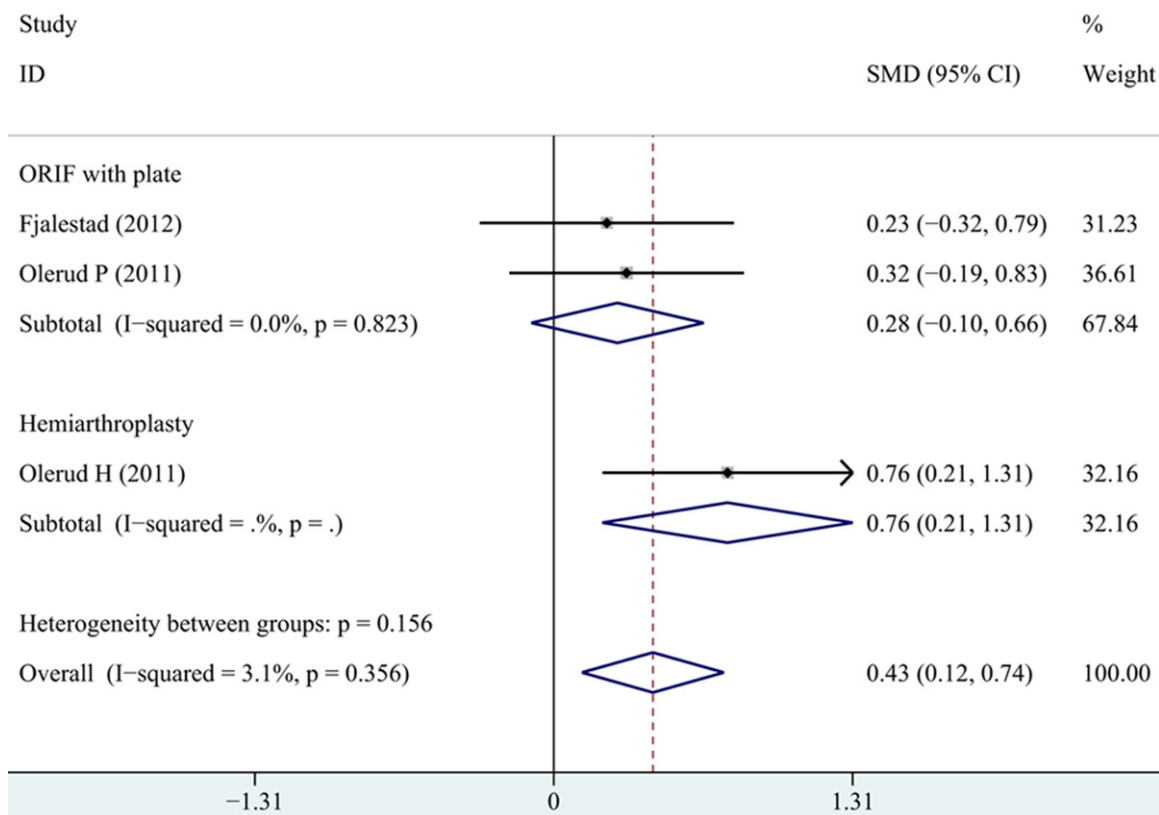


Figure 4. Forest plots for quality of life.

tures after intramedullary nailing or conservative treatment. The results showed that patients treated conservatively suffered less pain and gained better functional outcomes. Another study also demonstrated that patients treated conservatively gained better functional score of shoulder [19]. The results in this study could be explained by two reasons: 1. There is indeed no statistical difference existed. 2. The number included in this study was too small. Due to the low incidence of displaced proximal humeral fracture [1], it is difficult to perform large scaled RCTs. We hope more high quality RCTs will confirmed the issue.

Complications in surgical group were more common than that in conservative group. Bernhard et al [20] sorted postoperative complications into two types: non-implant-related (Malreduction, primary screw cutout, Malunion, nonunion, avascular necrosis, infection) and implant-related complications (secondary screw cut-out, glenoid destruction). The complication incidence of surgical treatment varies from 20% to nearly 40%, which is much more common than conservative method. Topical blood supply was

more or less affected in displaced proximal humeral fractures. Anatomical reduction of the fracture fragments surely brought further damage to soft tissue and their blood supply [21], resulting in nonunion and avascular necrosis. For displaced proximal humeral fracture, especially four-part fracture, the incidence of implant related complications and none implant related complications are higher [22]. For patients with conservative treatment, the process of fracture healing might be dramatically affected by soft tissue impacted in displaced fracture end. In comparison with surgical treatments, the complications in patients with conservative treatments were fairly low. All deaths mentioned in this article were unrelated with interventions, thus, death was not considered as the complication.

QoL of patients treated with surgical methods were better than that with conservative treatments. Theoretically, surgical methods provide more rigid fixation of fractures, especially in osteoporotic bone [23]. Primary fracture stability made the early active rehabilitation program and early mobilization of the shoulder possible,

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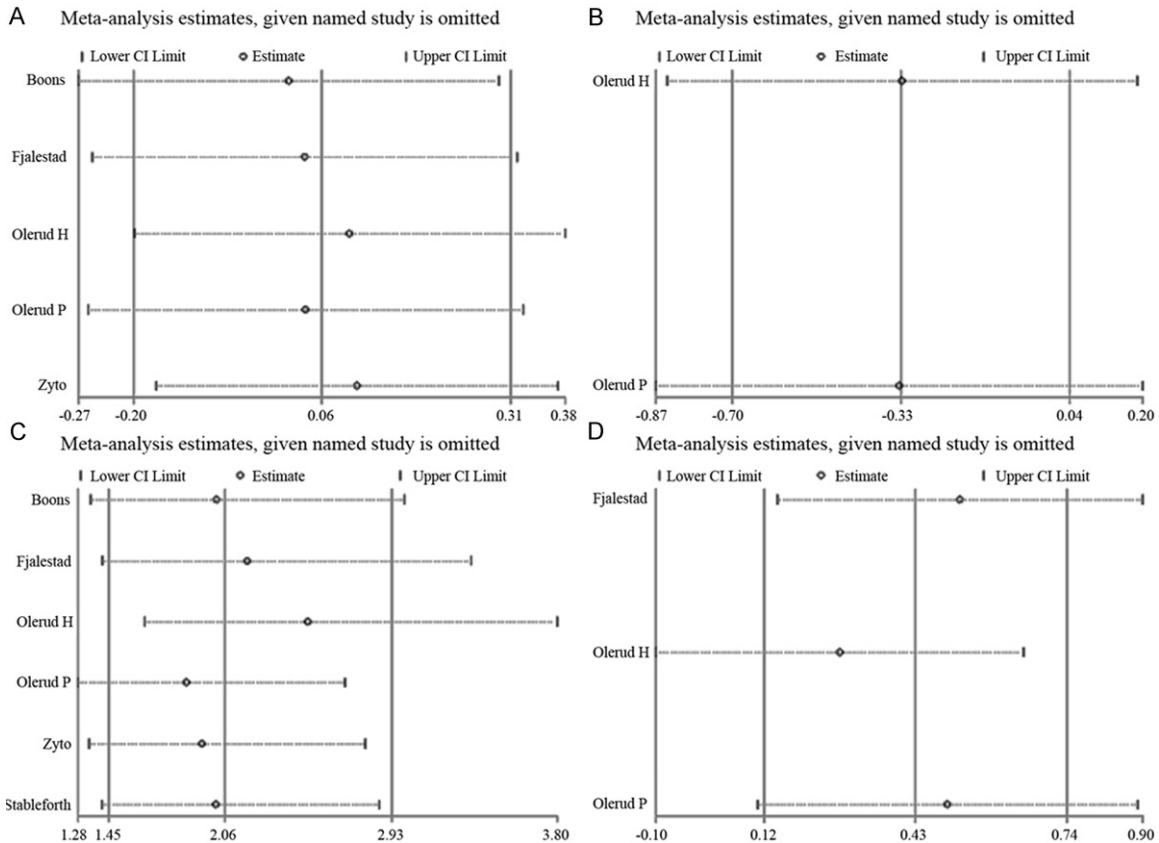


Figure 5. Sensitive analysis for Constant score (A), DASH (B), complications (C), quality of life (D).

which gained a better functional outcome and a good restoration of the activities of daily living [13, 24].

Although this meta-analysis was performed with the best available evidence presently, some unavoidable weaknesses deserved to be noted. First, the number of patients included is relative small. Epidemic investigation [15] showed that over 80% proximal humeral fractures were undisplaced or only minimally displaced. It is somewhat not easy to perform a large-scale RCT, thus, more well designed, high quality RCTs are needed to confirm the issue. Furthermore, blind method was difficult for surgical interventions because of ethical issue. Though assessor blind was mentioned in several researches, the psychological quality and surgical techniques of the surgeons might have a biased effect on final outcomes.

Conclusion

For displaced proximal humeral fractures in elderly patients, there was no difference for constant score and DASH between patients

with surgical and conservative treatment. Patients treated surgically gained better QoL but suffered more postoperative complications.

Disclosure of conflict of interest

None.

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