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Comparison of primary total hip arthroplasty with limited open reduction and internal fixation vs open reduction and internal fixation for geriatric acetabular fractures: a systematic review and meta-analysis

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- *Purpose:* Comminuted fractures with poor bone quality in the elderly are associated with poor outcomes. An alternative to open reduction and internal fixation (ORIF) alone, primary or acute total hip arthroplasty (aTHA), allows early mobilization with full weight bearing. In this study, we aim to analyze whether treatment of aTHA with/withtout ORIF (limited ORIF) vs ORIF alone yields better intra-operative results, functional outcomes, and less complications.
- *Methods:* PubMed, Cochrane, Embase, and Scopus databases were searched in accordance with the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines. Random-effects model and 95% confidence intervals were used. The outcomes of interest were surgery time, blood loss, length of hospital stay, Harris hip score (HHS), 36-Item Short Form Survey (SF-36), complication rate, surgical site infection rate, heterotopic ossification rate, reoperation rate, and mortality rate.
- *Results:* Ten observational studies with a total of 642 patients (415 ORIF alone and 227 aTHA with/without ORIF) were included in the systematic review. Compared to ORIF alone, aTHA with limited ORIF provided higher HHS ($P = 0.029$), better physical function ($P = 0.008$), better physical component summary ($P = 0.001$), better mental component summary ($P = 0.043$) in postoperative 1-year SF-36, lesser complication rate ($P = 0.001$), and lesser reoperation rate ($P = 0.000$), but however greater bodily pain ($P = 0.001$) in acetabular fractured elderlies.
- *Conclusions:* Acute THA with limited ORIF is favorable alternative to ORIF technique alone. It provided better HHS, physical, and mental component summary in SF-36 and yielded lower complication and reoperation rate compare to ORIF alone.

Keywords

- acute total hip arthroplasty
- primary total hip arthroplasty
- total hip replacement
- open reduction and internal fixation
- elderly
- acetabular fracture

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Introduction

The incidence of geriatric acetabular fractures has been reported to be 14% of all acetabular fractures (1) and 24% in patients aged over 60 years in the United States (2). This fast-expanding population increases 2.4-fold over a 27-year period (2, 3), with nearly half (49.8%) undergoing low-energy trauma and 63% accompanied with associated acetabular fractures. These fractures are featured by medio-cranial displacement of quadrilateral plate with anterior column involvement, associated femoral head injuries, and severe marginal impaction of the posterior column/wall (2). Those fractures where the posterior column is involved can increase the complexity of aTHA. Stable fixation and satisfactory reduction can be challenging due to osteoporotic bone which may hinder stable osteosynthesis and is therefore associated with a poor outcome in elderly patients (4). In the elderly, 17%–30.4% require delayed total hip arthroplasty (THA) after open reduction and internal fixation (ORIF)

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treatment (5) , which leads to high complication rates (6) and less satisfaction (7, 8), contrary to 12.9%–15.1% conversion rate in patients aged below 60 years (9, 10).

Early mobilization is a crucial issue after surgery for periarticular acetabular fractures in the elderly (11). Nevertheless, the elderly appeared to be disobedient with weight-bearing restrictions (12) as postoperative protocols restrained weight bearing for up to 2 months after acetabular fixation (13). Therefore, ORIF in combination with acute THA (aTHA) or aTHA without ORIF has been advocated (4, 14). The advantages of this approach are acceptable for anatomic reduction, allowance for early mobilization with full weight bearing (15), avoiding delayed THA surgery due to fixation failure or secondary osteoarthritis (16), bearing equivalent non-fatal complication rate as ORIF (5), and rendering a painless and stable hip for the elderly (17). However, more blood loss, longer anesthetic time, and technical difficulties in aTHA ± ORIF approach are drawbacks likely to encounter in the operation (18).

Today, controversy exists with regard to optimal management of acetabular fractures in this population. The purpose of this meta-analysis and systematic review was to analyze perioperative variables and clinical outcomes, such as surgery time, blood loss, length of hospital stays, Harris hip score (HHS), 36-Item Short Form Survey (SF-36), complication rate, surgical site infection rate, and reoperation rate and mortality rate of ORIF alone vs aTHA with/without ORIF (limited ORIF) in acetabular fractured elderlies.

Method

Search strategy

The study was performed in accordance with the Preferred Reporting Items for Systematic Review and Meta-analysis (PRISMA) guidelines. PubMed, Cochrane, Embase, and Scopus databases were searched up to June 18, 2021, using the following search terms: ederly, acetabular fracture, replacement, and open reduction and internal fixation (ORIF). Randomized controlled trials (RCTs), and prospective or retrospective cohort studies were included. Included studies were acetabular fractures primary treated by aTHA or ORIF in elderly patients (aged over 50 years old). Studies had to report perioperative variables and clinical outcomes. Comments, letters, case report, case series, editorials, proceedings, and personal communication were excluded. The search strategies were illustrated in the supplement. No language or date restriction was applied to our systematic search. Meta-analysis does not involve human subjects and, therefore, does not require institutional review board review, ethical approval, and informed consent.

Study selection and data extraction

Studies were reviewed and selected by two independent reviewers. Where there was uncertainty regarding study eligibility, a third reviewer was consulted. The following details were extracted from the included studies: the name of the first author, year of publication, sample size, participants' age, follow-up period, AO/OTA classification, Judet and Letournel classification, approach method, Charlson comorbidity index, injury severity score, trauma energy, trauma type, time of trauma to surgery, and outcomes in concern.

Quality assessment

The quality of the included cohort studies was assessed by the Newcastle–Ottawa scale (NOS) (19) with two independent reviewers. The NOS evaluation included selection bias (four items), comparability bias (one item), and outcome bias (three items). Except for the comparability item with a maximum of two 'stars', the other each item was assigned at most one 'star' if 'high'

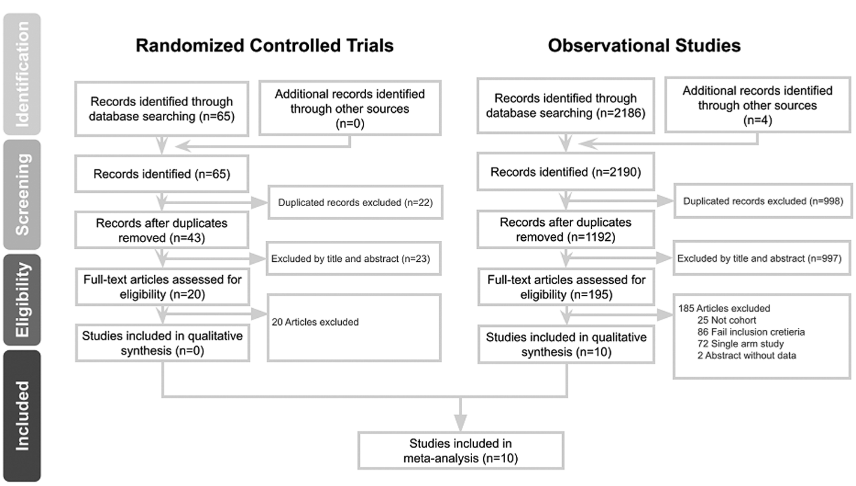

Figure 1
PRISMA flow diagram of study selection.

Table 1 Demographic characteristics of the studies included in the systematic review.

Study/ Group	Sample size			Age, years*	Follow-up, months*	ASA score, Score: *n*‡	CCI, Score: *n*‡	Trauma energy		Trauma type			ISS
	Total	Male	Female					Low	High	Fall	TA	Other	
Boelch *et al.* (22)							NA	NA		NA			NA
ORIF	23	17	6	73.4 (59–92)	9.5 (2.3–19.6)	2.57: 1–4							
aTHA ± ORIF	9	5	4	79.8 (63–90)	4.5 (2.5–9.5)	2.67: 2–4							
Borg *et al.* (16)					6,12,24,60		NA						NA
ORIF	14	9	5	68.2 (50–83)		I: 3; II: 8; III: 3; IV: 0		7	7	7	7	0	
aTHA+ORIF	13	8	5	76.5 (64–89)		I: 0; II: 6; IIIL: 6; IV: 1		8	5	9	4	0	
Carroll *et al.* (23)				67 ± 8.3 (56–89)	63.7 ± 39.5 (24–188)	NA	NA	NA		47	44	2	NA
ORIF	58												
aTHA+ORIF	9												
Carta *et al.* (24)					39.6 (3–96)		NA			NA			
ORIF	31	20	11	73.2 (65–93)		3		20	11				22.6 (12–42)
aTHA+ORIF	30	20	10	76.7 (65–86)		3		14	16				22.6 (13–42)
Folsch *et al.* (25)				76.9 (65–93)	68.4 (18–120)	NA	NA	NA		14	10	0	NA
ORIF	10												
aTHA+ORIF	14												
Gary *et al.* (26)					12	NA		NA		NA			
ORIF	174	116	58	70.3 ± 8.5 (63–76)			2.0 ± 1.5						12.9 ± 7.3
aTHA+ORIF	30	20	10	77.1 ± 8.2 (71–84)			4.0 ± 1.4						9.8 ± 7.1
Lannes *et al.* (27)										NA			NA
ORIF	25	20	5	75 ± 8 (66–92)	12 (1–56)	I: 1; II: 12; III: 12; IV: 0	0: 8; 1–3: 13; >4: 4	14	11				
aTHA+ORIF	26	15	11	78 ± 6 (66–88)	12 (1–96)	I: 0; II: 14; III: 10; IV:2	0: 10; 1–3: 12; >4: 4	17	9				
Lont *et al.* (28)						NA		NA					NA
ORIF	25	18	7	69 (58–83)	4.2 (0–9)		4 (*P* = 0.1)			21	1	3	
aTHA+ORIF	34	24	10	71 (56–92)	1.4 (0–6)		5			27	5	2	
Weaver *et al.* (29)					22 (6–89)	NA	NA	NA					NA
ORIF	33	19	14	73 (65–88)						11	22	0	
aTHA+ORIF	37	19	18	79 (66–90)						29	7	1	
Manson *et al.* (30)					6,12	NA	NA			NA			NA
ORIF	22	14	8	70.7 ± 8.7				11	11				
aTHA+ORIF	25	18	7	72.8 ± 8.0				7	18				

‡*n* represents number of patients; *presented as mean ±S.D. (range).
ASA score, American Society of Anaesthesiologists; aTHA, acute total hip arthroplasty; CCI, Charlson comorbidity index; DM-CHP, dual mobility-combined hip procedure; ISS, injury severity score; ORIF, open reduction and internal fixation; TA, traffic accident.

Table 2 Distribution of patients in the studies according to the AO/OTA and Letournel classifications.

Study/ Group	AO/OTA			Letournel classification									
	62A	62B	62C	Post. wall	Post. col.	Ant. wall	Ant. Col.	Trans.	Post. col + post. wall	Trans. + post. wall	T type	Ant. col. + PH	Both columns
Boelch *et al.* (22)													
ORIF	7	1	15	3	0	0	3	0	1	0	0	1	15
aTHA ± ORIF	3	2	4	0	0	2	1	2	0	0	0	0	4
Borg *et al.* (16)	NA												
ORIF				4	-	-	-	-	0	1	-	7	2
aTHA + ORIF				1	–	–	–	–	1	1	–	5	4
Carroll *et al.* (23)	28	39	26	15	0	2	6	2	5	10	7	20	26
Carta *et al.* (24)													
ORIF	9	20	2	0	0	0	0	0	9	10	1	9	2
aTHA + ORIF	8	19	3	0	0	0	0	0	8	8	1	10	3
Folsch *et al.* (25)	12	9	3	2	6	0	4	4	0	2	3	0	3
Gary *et al.* (26)													
ORIF	79	66	29	38	2	0	17	4	22	24	7	31	29
aTHA + ORIF	12	16	2	5	1	2	4	4	0	3	3	6	2
Lannes *et al.* (27)													
ORIF	7	11	7	5	1	1	0	0	0	0	2	9	7
aTHA + ORIF	5	16	5	3	0	0	1	5	1	2	3	6	5
Lont *et al.* {(28)													
ORIF	7	17	1	1	0	0	5	0	1	0	16	1	1
aTHA + ORIF	5	24	5	2	0	0	1	1	2	2	19	2	5
Weaver *et al.* (29)	NA												
ORIF				9	–	–	–	3	–	6	–	5	4
aTHA + ORIF				7	–	–	8	–	–	4	3	6	4
Manson *et al.* (30)	NA												
ORIF				12									‡13 / 5
aTHA + ORIF				14									‡13 / 9

‡Dome impaction/femoral head fracture.ant. col., anterior column; ant. wall, anterior wall; post. wall, posterior wall; post. col., posterior column; trans., transverse; PH, posterior hemitransverse.

quality was identified. The full score for NOS is 9 stars. A study with the score of 8–9 stars, 57 stars, or less than 5 stars was recognized as high, moderate, or low quality, respectively. After all studies were rated independently, consensus was reached through discussion.

Outcome measures

Outcomes of interest were perioperative variables and clinical outcomes, such as surgery time, blood loss, length of hospital stays, HHS, 36-item Short Form Survey (SF-36), complication rate, surgical site infection rate, heterotopic ossification rate, reoperation rate, and mortality rate.

Statistical analysis

Continuous data were assessed using mean difference (MD) or standardized mean difference (SMD) with corresponding 95% confidence interval (95% CI). Dichotomous data were assessed using relative risk (RR) and 95% CI. $P < 0.05$ was regarded as statistically significant. The heterogeneity of the studies was assessed by the Cochrane Q test with the I^2 statistic. The I^2 statistic was defined as follows: 0–24% = low heterogeneity; 25–49% = moderate heterogeneity; 50–74% = high heterogeneity; and 75–100% = extreme heterogeneity. As the number of studies included in the meta-analysis was small, heterogeneity tests had low statistical power (20). Since the heterogeneity between studies were observed, we applied random-effect models conservatively for meta-analysis (21). Pooled effects sizes were calculated, and a two-sided P value <0.05 was considered to indicate statistical significance. All analyses were performed using Comprehensive Meta-Analysis statistical software, version 3.0 (Biostat, Englewood, NJ, USA).

Result

Search results

A total of 2255 studies were identified in the initial research (Fig. 1). We excluded 1020 duplicates and 1020 irrelevant studies by reviewing titles and abstracts. Two hundred and fifteen studies underwent full-text review and 205 were excluded for reviews or case series or one arm study or different inclusion criteria or without full text abstracts. Finally, ten studies (16, 22, 23, 24, 25, 26, 27, 28, 29, 30) were included in the systematic review.

Study characteristics

The main demographics of these 10 studies included were summarized in Tables 1 and 2. All studies were observational studies in design. The total number of patients in the studies was 642 and they were divided into ORIF group (ORIF alone, $n = 415$) and aTHA ± ORIF group

Table 3 Treatment of groups according to ORIF approach.

Study/group/subgroup	Cases, *n*	Total cases	Assigned criteria	ORIF approach	Fixation
Boelch *et al*. (22)					
ORIF		23	Age >54 years, low-energy trauma-induced fracture, Singh index of <4		Plates/screws
Both columns	16			PA / AA / ; PA+AA /; PA+AIP	
Ant.col. involved	4			AA	
Post. wall involved	3			PA	
aTHA		5		NA	NA
Post. Col. stable	2				
aTHA+ORIF		4	Severe comminution+insufficient reconstruction, concomitant femoral head fracture, Singh index=2+comminution+infection high risk		
Post. Col. unstable	4			PA	Reconstruction plating before cage implantation
Borg *et al*. (16)					
ORIF		14	Severe acetabular impaction +/− concomitant femoral head injury		Plates/screws
Post. col. unstable	5			PA	
Ant. col.unstable	8			AA	
Others	1			PA+AA	Plates
aTHA+ORIF		13	Severe comminuted fracture, marginal impaction		Plates / screws
NA	11			PA	
Carroll *et al*. (23)					
ORIF					
Acceptable reduction	58	58	Acceptable reduction, <4 hours OP time	AA / PA	Plates/screws
aTHA+ORIF				AA / PA	
Irreducible	9	9	Irreducible, OP >4 hours, severe acetabular or femur head impaction, displaced femur neck fracture, OA, osteoporosis		Plates/screws
Carta *et al*. (24)			Based on patients' decision		
ORIF		31			
Others	19			AA / PA / ; PA+AA	NA
QPD	9				Wiper plates
	3			AA	Over-pectineal / intra-pectineal plates
aTHA+ORIF		30			Posterior stabilization: plate/screws Anterior stabilization: screws
NA	29			PA	
	1 (Tile C1)			AA	

AIP, anterior intrapelvic approach (modified Stoppa approach); AA, anterior approach (ilioinguinal), APC, Anti-protrusion cage; Ant. col, anterior column; aTHA, acute total hip arthroplasty; DLA, direct lateral approach (transgluteal Bauer approach); NA, not available; OA, osteoarthritis; OP, operation; ORIF, open reduction and internal fixation; PA, posterior approach (Kocher–Langenbeck, Southern); Post. Col., posterior column; QPD, quadrilateral plate displacement.

(aTHA with/without ORIF, or aTHA with limited ORIF, $n=227$). The AO/OTA classification varied across studies with most patients with 62B fracture pattern (Table 2). The mean age among the studies ranged from 67 to 79.8 years. The mean length of follow-up ranged from 1.4 to 68.4 months. Table 3 showed the details of treatments in each group. For the fixation, anterior approach or anterior intrapelvic approach was largely chosen when anterior column was involved; posterior approach was chosen when the posterior column/wall was involved. On the other hand, for the replacement, posterior approach or direct lateral approach was largely chosen. Bruch–Schneider anti-protrusion cage and cemented acetabular cup were commonly used. Cementing of femoral stem depended mainly on the bone quality of femur (Table 4).

Summary of outcomes

The outcomes of interest in each study are listed in Table 5. The total complication rate accounts for 50.3% in ORIF group and 14.4% in aTHA ± ORIF group; with 38.6% and 8.5% patients underwent reoperation in ORIF group and aTHA ± ORIF group, respectively. Among those who underwent reoperation in ORIF group, 92% patients received secondary THA. Surgical site infection rate was higher in ORIF group (7.0%) than in aTHA ± ORIF group (3.4%) but without significant difference ($P=0.330$). Heterotopic ossification rate was higher in aTHA ± ORIF (18.8%) than in ORIF alone group (12.1%) but without significant difference ($P=0.504$). Overall mortality rate was higher in aTHA ± ORIF group (11.9%) than in

Table 4 Treatments of patients by aTHA approach.

Study/Group/Subgroup	aTHA approach	Dual mobility component	Bone graft	Anti-protrusion cage/ reinforcement ring	Acetabular cup cemented	Femoral stem cemented
Boelch *et al.* (22)						
ORIF	NA	NA	NA	NA	NA	NA
Both columns						
Ant. col. involved						
Post. wall involved						
aTHA						
Post. Col. stable	PA		.			(+)
aTHA + ORIF		NA	(+) Femoral head autograft	(+) Burch–Schneider Cage*	(+) To prevent THR luxation, cemented the cup by 10~15 degrees anteversion and 30~40 degrees inclination	(+)
Post. Col unstable	PA					
Borg *et al.* (16)						
ORIF	NA	NA	NA	NA	NA	NA
aTHA + ORIF	DLA	(+)	(+) Femoral head autograft	(+) Burch–Schneider Ring†	(+) Cemented the dual mobility component to prevent dislocation	(+)
Carroll *et al.* (23)						
ORIF	NA	NA	NA	NA	NA	NA
aTHA + ORIF	NA	NA	NA	NA	NA	NA
Carta *et al.* (24)						
ORIF	NA	NA	NA	NA	NA	NA
aTHA + ORIF	PA; NA			22 cases: Ring + semi-elliptical cemented cup with bi-articular mobility polyethylene insert; 8 cases: trabecular metal acetabular revision system with cemented polyethylene insert‡		Cemented femoral stem (due to scare bone stock): 10 cases; long hydroxyapatite coated femoral stem: 20 cases

†Fixed the ring with 6.5 mm cancellous screws.‡Reach A-frame equivalent, stabilizing front and rear columns; Anterior segment reduction: with screws through ring or through the acetabular revision; all polyethylene insert was cemented with 15~35 degrees inclination and 10~15 degrees anteversion.
aTHA, acute total hip arthroplasty; ORIF, open reduction and internal fixation; DLA, direct lateral approach (Transgluteal Bauer approach).

ORIF group (6.6%) but without significant difference ($P = 0.274$).

Quality assessment

Newcastle–Ottawa was used to evaluate the quality of all nine studies (Supplementary Tables 1 and 2, see section on supplementary materials given at the end of this article). Boelch 2017 (22) and Lannes 2020 (27) were considered moderate quality mainly due to high risk of comparability bias, while the others high quality.

Meta-analysis

All studies were included in the meta-analysis and evaluated the differences for the interested outcomes. There were no significant differences in surgical time (MD = −21.673, $P = 0.377$; Fig. 2), blood loss (MD = −185.766, $P = 0.427$; Fig. 3), length of stay (MD = −1.268, $P = 0.514$; Fig. 4), surgical site infection rate (RR = 1.641, $P = 0.330$; Fig. 5), and heterotopic ossification rate (RR = 0.798, $P = 0.504$; Fig. 6) between two groups. After the surgery, HHS was significantly higher, or better functional score, in the THA ± ORIF group (MD = −13.755, $P = 0.029$; Fig. 7). The SF-36 questionnaire showed that the aTHA ± ORIF group bear greater bodily pain (MD = -13.045, $P = 0.001$; Fig. 8), better physical function (MD = -6.475, $P = 0.008$), better physical component summary (MD = −4.721, $P = 0.001$), and better mental component summary (MD = −3.250, $p = 0.043$) (Tables 6 and 7). Complication rate (RR = 3.040, $P = 0.007$; Fig. 9) and reoperation rate (RR = 3.411, $P = 0.001$; Fig. 10) were much less in aTHA ± ORIF group. Mortality rate (RR = 0.652, $P = 0.274$; Fig. 11) was higher in the aTHA ± ORIF group than in the ORIF group.

The overall heterogeneity was extreme in surgical time ($I^2 = 87.600\%$) and high in blood loss ($I^2 = 55.924\%$), HHS ($I^2 = 65.810\%$), and complication rate ($I^2 = 65.272\%$).

Discussion

This quantitative comparative meta-analysis compares ORIF and aTHA ± ORIF procedure for the treatment of acetabular fractures in elderlies. As a result, ten observational studies were included with a total of 642 patients in this meta-analysis. Most elderlies bear moderate severity of comorbidities with average age ranged from 67 to 79.8 years old. Most patients suffered

Table 5 Patients' outcomes presented in the studies. Data are presented as median (range) or as mean ± S.D.

Study/group	Trauma to surgery, days Mean (range)	Surgical time, min Median (range)	P	Blood loss, mL Median (range)	P	Length of stay, days	Harris hip score
Boelch *et al.* (22)							
ORIF	6 (2–18)	137 (70–245)*	0.013	576 (0–1500)*		21 (8–56)*	NA
aTHA ± ORIF	4 (1–9)	189 (136–266)*		533 (0–2000)*		25.6 (9–74)*	NA
Borg *et al.* (16)							
ORIF	NA	166 (95–354)	0.22	675 (300–2600)	0.68	NA	NA
aTHA+ORIF	NA	188 (175–321)		800 (400–1700)		NA	NA
Carroll *et al.* (23)	7.3 (1–22)	244 (89–403)		NA		NA	NA
Carta *et al.* (24)							
ORIF	NA	NA		NA		16.3 (10–22)*	70.2 (62–90)*
aTHA+ORIF						16.7 (10–21)*	78.1 (66–92)*
Folsch *et al.* (25)	NA	NA		NA		NA	NA
Gary *et al.* (26)							
ORIF	4.0 ± 4.3	NA		NA		11.9 ± 13.6	NA
aTHA+ORIF	9.7 ± 13.3	NA		NA		11.9 ± 7.8	NA
Lannes *et al.* (27)							
ORIF	NA	125 (54–305)	<0.0001	500 (200–1800)	0.006	14 (1–46)†	68.25 ± 21.20
aTHA+ORIF	NA	185 (106–272)		1000 (369–1700)		11 (3–46)	72.36 ± 11.65
Lont *et al.* (28)							
ORIF	NA	218 (120–321)	0.01	1400 (300–3700)	0.4	NA	NA
aTHA+ORIF	NA	169 (97–310)		1100 (400–2700)		NA	NA
Weaver *et al.* (29)							
ORIF	NA	NA		NA		NA	63‡
aTHA+ORIF	NA	NA		NA		NA	82
Manson *et al.* (30)							
ORIF	NA	NA		NA		NA	71.5 ± 26.7
aTHA+ORIF	NA	NA		NA		NA	92.5 ± 7.5

*Mean (range); †$P = 0.32$; ‡$P = 0.06$.

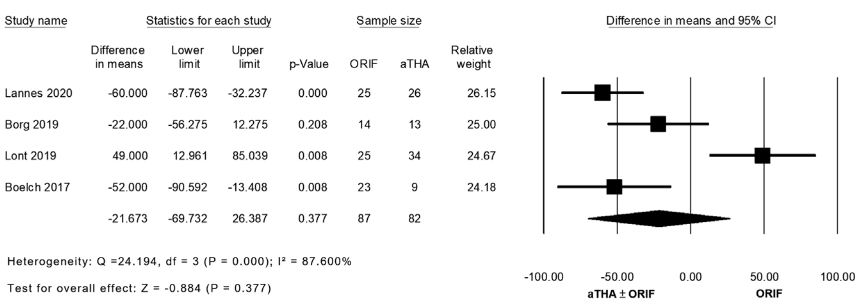

Figure 2
Forest plot of the mean difference of surgery time (min) comparing ORIF alone to aTHA ± ORIF.

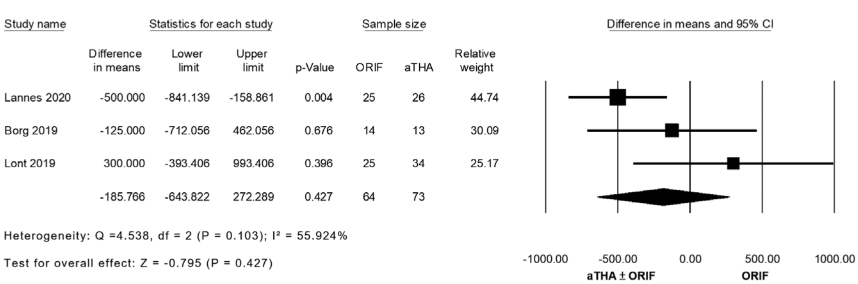

Figure 3
Forest plot of the mean difference of blood loss (mL) comparing ORIF alone to aTHA ± ORIF.

from 62B acetabular fracture pattern based on the AO/OTA classification with the majority of injuries was low-energy falls. A total of 415 patients underwent ORIF procedure and 227 received aTHA ± ORIF procedure. Commonly used approaches were anterior approach, posterior approach, or combination approach. As a result, we found aTHA with ORIF compared to ORIF procedure alone, yield higher HHS, better physical function, physical component summary, and mental component summary in SF-36, lesser complication and reoperation rate.

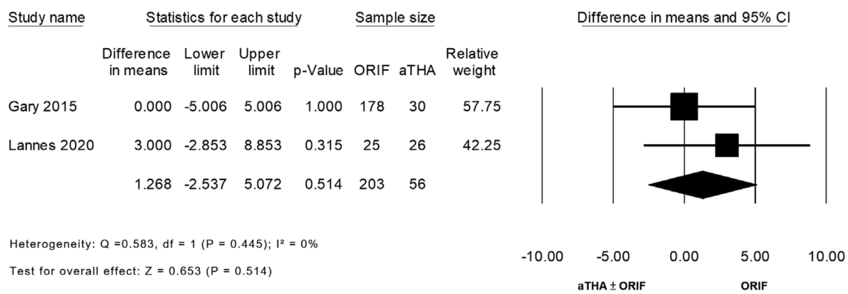

Figure 4
Forest plot of the mean difference of length of stay (day) comparing ORIF alone to aTHA ± ORIF.

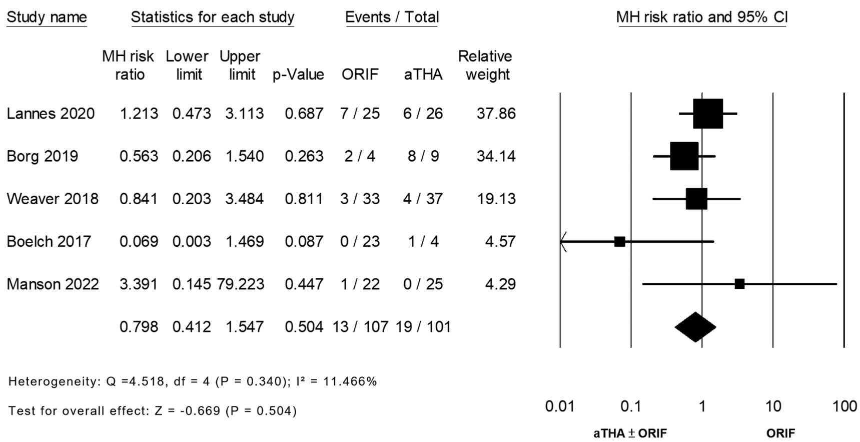

Figure 5
Forest plot of the risk ratio of surgical site infection rate comparing ORIF alone to aTHA ± ORIF.

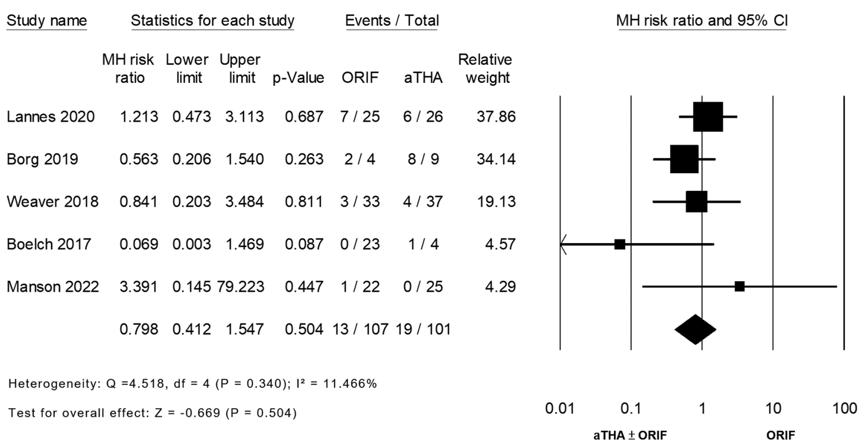

Figure 6
Forest plot of the risk ratio of heterotopic ossification rate comparing ORIF alone to aTHA ± ORIF.

However, patients in aTHA ± ORIF group suffered more bodily pain after surgery.

Treatment of acetabular fractures in the elderly is argumentative (31). Conservative treatment often brought discouraging outcomes (32). Operative treatment, though commonly performed in fractures with dislocation and instability (33), yielded discordant results even in skillful surgeons' hands (23). Other than ORIF, alternatives are percutaneous or minimally invasive reduction and acute or delayed THA (22). Despite the disputable treatment options, general consensus are the necessities for verticalization and early mobilization of the patient, in order to restore the pre-traumatic function and reduce complications (24).

Most acetabular fractures (63%) in the elderly (2) were associated fractures which may require multidisciplinary approach (24). Difficulties arose from achieving anatomical and stable reduction of the affected hip joint in older patients with osteoporotic bones (34, 35), especially in the setting of fracture

Study name	Difference in means	Lower limit	Upper limit	p-Value	ORIF	aTHA	Relative weight
Lannes 2020	-4.110	-13.449	5.229	0.388	25	26	40.21
Manson 2022	-21.000	-31.911	-10.089	0.000	22	25	37.09
Weaver 2018	-19.000	-38.470	0.470	0.056	33	37	22.70
	-13.755	-26.091	-1.418	0.029	80	88	

Heterogeneity: Q = 5.850, df = 2 (P = 0.054; I² = 65.810%)

Test for overall effect: Z = -2.185 (P = 0.029)

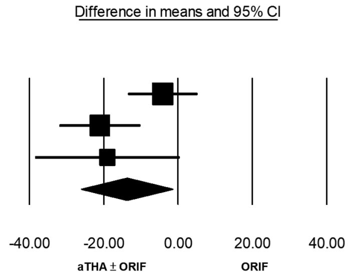

Figure 7

Forest plot of the standard mean difference of Harris hip score comparing ORIF alone to aTHA ± ORIF.

Group by Outcome	Study name	Difference in means	Lower limit	Upper limit	p-Value	ORIF	aTHA	Relative weight
Bodily Pain	Weaver 2018	-9.000	-17.424	-0.576	0.036	33	37	60.29
Bodily Pain	Folsch 2015	-17.000	-30.796	-3.204	0.016	10	14	26.35
Bodily Pain	Borg 2019	-23.500	-43.411	-3.589	0.021	14	11	13.36
Bodily Pain		-13.045	-20.519	-5.571	0.001			
Emotion	Weaver 2018	-5.200	-16.493	6.093	0.367	33	37	69.51
Emotion	Folsch 2015	-10.000	-27.208	7.208	0.255	10	14	29.94
Emotion	Borg 2019	-50.000	-177.516	77.516	0.442	14	11	0.55
Emotion		-6.881	-16.297	2.534	0.152			
General Health	Borg 2019	0.500	-2.968	3.968	0.777	14	11	79.21
General Health	Weaver 2018	-1.900	-10.328	6.528	0.659	33	37	13.41
General Health	Folsch 2015	-5.000	-16.361	6.361	0.388	10	14	7.38
General Health		-0.228	-3.314	2.859	0.885			
Mental Health	Borg 2019	-2.000	-6.287	2.287	0.361	14	11	59.16
Mental Health	Weaver 2018	6.500	-2.032	15.032	0.135	33	37	30.47
Mental Health	Folsch 2015	-2.000	-19.042	15.042	0.818	10	14	10.37
Mental Health		0.590	-5.257	6.437	0.843			
Physical Function	Weaver 2018	-5.000	-9.680	-0.320	0.036	33	37	84.23
Physical Function	Folsch 2015	-14.000	-27.586	-0.414	0.043	10	14	12.04
Physical Function	Borg 2019	-15.500	-40.137	9.137	0.218	14	11	3.73
Physical Function		-6.475	-11.255	-1.696	0.008			
Role Physical	Borg 2019	0.000	-10.413	10.413	1.000	14	11	41.78
Role Physical	Weaver 2018	-5.700	-16.176	4.776	0.286	33	37	41.29
Role Physical	Folsch 2015	-10.000	-26.360	6.360	0.231	10	14	16.93
Role Physical		-4.046	-10.777	2.685	0.239			
Social Function	Weaver 2018	-5.900	-16.081	4.281	0.256	33	37	54.22
Social Function	Folsch 2015	-1.000	-16.166	14.166	0.897	10	14	24.43
Social Function	Borg 2019	-13.000	-29.226	3.226	0.116	14	11	21.35
Social Function		-6.218	-13.715	1.278	0.104			
Vitality	Folsch 2015	-16.000	-28.798	-3.202	0.014	10	14	41.69
Vitality	Weaver 2018	0.100	-15.480	15.680	0.990	33	37	34.93
Vitality	Borg 2019	5.000	-16.989	26.989	0.656	14	11	23.38
Vitality		-5.466	-18.512	7.579	0.412			
Physcial summury	Borg 2019	-2.700	-5.132	-0.268	0.030	14	11	40.50
Physcial summury	Folsch 2015	-5.900	-10.344	-1.456	0.009	10	14	23.47
Physcial summury	Manson 2022	-2.900	-7.920	2.120	0.258	22	25	20.14
Physcial summury	Carroll 2010	-11.800	-19.782	-3.818	0.004	58	9	10.05
Physcial summury	Weaver 2018	-8.100	-19.004	2.804	0.145	33	37	5.85
Physcial summury		-4.721	-7.500	-1.943	0.001			
Mental summury	Borg 2019	-5.500	-8.117	-2.883	0.000	14	11	41.25
Mental summury	Folsch 2015	-1.200	-7.050	4.650	0.688	10	14	19.23
Mental summury	Carroll 2010	-6.900	-13.800	0.000	0.050	58	9	15.25
Mental summury	Manson 2022	0.600	-6.529	7.729	0.869	22	25	14.53
Mental summury	Weaver 2018	2.200	-6.978	11.378	0.638	33	37	9.74
Mental summury		-3.250	-6.391	-0.110	0.043			

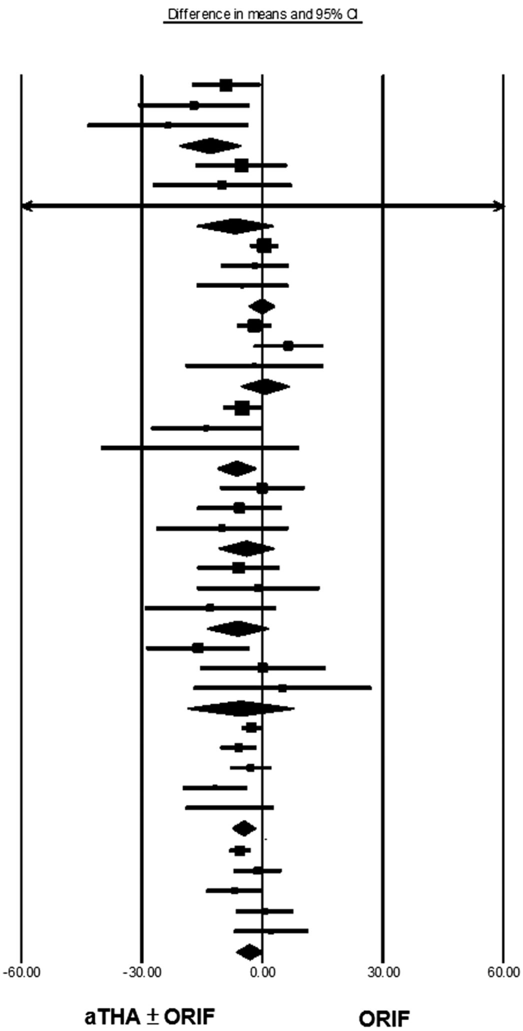

Figure 8

Forest plot of the mean difference of SF-36 subgroup comparing ORIF alone to aTHA ± ORIF.

comminution and impaction of the articular surface. It is commonly accepted that the quality of the reduction determines predominantly the successfulness of ORIF (36, 37). These preoperative features exemplify lower possibility to obtain anatomical reduction, including female gender, older age, osteoporosis, subchondral hematoma (15), associated injury of the two columns, segmental injury of the quadrilateral plate, the Gull sign, femoral head damage, marginal impaction, posterior wall comminution (38), fragment impaction in the acetabular weight-bearing-area dome (39, 40), delayed surgery (33) (more than 11 days after the trauma), and preexisting symptomatic hip arthritis (34). The primary objective when performing the reduction

Table 6 Outcomes of interest presented in the studies.

Study/Group	Complication rate	Surgical site Infection rate	Postoperative Reduction*	Heterotopic Ossification	Dislocation	Secondary THA	Reoperation rate	Mortality rate
Boelch *et al.* (22)								
ORIF	11 / 23 (47.8%)	2 / 23 (8.7%)	11 / 4 / 6	0 / 23 (0%)	–	5 / 11 (45.5%)	6 / 11 (54.5%)	1 / 23 (4.3%)
aTHA ± ORIF	2 / 9 (22.2%)	0 / 9 (0%)	–	1 / 4 (25%)	1 / 9 (11.1%)	–	2 / 9 (22.2%)	0 / 9 (0%)
Borg *et al.* (16)								
ORIF	10 / 14 (71.4)	0 / 14 (0%)	NA	2 / 4 (50%)	–	9 / 14 (64.3%)	10 / 14 (71.4%)	0 / 14 (0%)
aTHA+ORIF	1 / 13 (7.7%)	0 / 13 (0%)	NA	8 / 9 (89%)	0 / 13 (0%)	–	0 / 13 (0%)	3 / 13 (23.1%)
Carroll *et al.* (23)	NA	NA		NA				NA
ORIF			19 / 29 / 10		–	26 / 58 (44.8%)	26 / 58 (44.8%)	
aTHA+ORIF			–		1 / 9 (11.1%)	–	2 / 9 (22.2%)	
Carta *et al.* (24)		NA	NA	NA	NA	NA	NA	
ORIF								1 / 31 (3.2%)
<3 months	2 / 31 (6.5%);							
>3 months	23 / 31 (74.2%)							
aTHA+ORIF								1 / 30 (3.3%)
<3 months	3 / 30 (10%)							
>3 months	0 / 30 (0%)							
Folsch *et al.* (25)	NA	NA		16 / 24 (67%)	NA	NA		NA
ORIF			4 / 5 / 1				2 / 10 (20%)	
aTHA+ORIF			–				0 / 14 (0%)	
Lannes *et al.* (27)								
ORIF	8 / 25 (32%)	1 / 25 (4%)	18 / - / -	7 / 25 (28%)	–	4 / 25 (16%)	5 / 25 (20%)	1 / 25 (4%)
aTHA+ORIF	8 / 26 (30.8%)	2 / 26 (7.7%)	–	6 / 26 (23%)	2 / 26 (7.7%)	–	2 / 26 (7.7%)	1 / 26 (3.8%)
Lont *et al.* (28)								
ORIF	10 / 25 (40%)	1 / 25 (4%)	25 / 0 / 0	NA	–	9 / 25 (36%)	9 / 25 (36%)	2 / 25 (8%)
aTHA+ORIF	2 / 34 (5.9%)	0 / 34 (0%)		NA	1 / 34 (2.9%)	–	1 / 34 (2.9%)	1 / 11 (9.1%)
Weaver *et al.* (29)								
ORIF	10 / 33 (30.3)	4 / 33 (12.1%)	NA	3 / 33 (9%)	–	6 / 33 (18.2%)	10 / 33 (30.3%)	5 / 33 (15.2%)
aTHA+ORIF	7 / 37 (18.9%)	3 / 37 (8.1%)	NA	4 / 37 (11%)	4 / 37 (10.8%)	–	5 / 37 (13.5%)	9 / 37 (24.3%)
Manson *et al.* (30)								
ORIF	13 / 22 (59.1%)	2 / 22 (9.1%)	NA	1 / 22 (4.5%)	–	9 / 22 (40.9%)	10 / 22 (45.5%)	NA
aTHA+ORIF	2 / 25 (8%)	0 / 25 (0%)	NA	0 / 25 (0%)	0 / 25 (0%)	–	2 / 25 (8.0%)	NA
Total								
ORIF	87 / 173 (50.3%)	10 / 142 (7.0%)	NA	13 / 107 (12.1%)	–	68 / 188 (36.2%)	78 / 198 (39.4%)	10 / 151 (6.6%)
aTHA ± ORIF	25 / 174 (14.4%)	5 / 144 (3.4%)	NA	19 / 101 (18.8%)	9 / 153 (5.8%)	–	14 / 167 (8.4%)	15 / 126 (11.9%)

*Postoperative Reduction defined by Matta *et al.* (30): anatomic/imperfect/poor.

Table 7 Patients' outcomes presented in the studies as reported in the SF-36 questionnaire. Results are presented as median (range) or as mean ± S.D.

Study/group	1-year SF-36 questionnaire criteria									
	Phy. func	Role Phy	Pain	Gen. Health	Vitality	Soc. Fun.	Emotion	MH	PCS	MCS
Borg *et al.* (16)										
ORIF†–	27.5 (0.23)	0 (0.51)	27.5 (0.03)	62.5 (0.78)	45 (0.66)	50 (0.13)	0 (0.45)	62 (0.37)	29.5 (0.04)	40.8 (0.00)
aTHA+ORIF‡	43	0	51	62	40	63	50	64	32.2	46.3
Carroll *et al.* (23)										
ORIF	46.1 ± 11.8							51 ± 10.1		
aTHA+ORIF	57.9 ± 7.6							57.9 ± 7.6		
Carta *et al.* (24)										
ORIF	74.2 (56-92)*									
aTHA+ORIF	81.2 (66–96)*									
Folsch *et al.* (25)										
ORIF	48 ± 21	56 ± 24	52 ± 17	55 ± 14	50 ± 20	77 ± 22	68 ± 20	81 ± 21	35.2 ± 6.1	53.6 ±7.5
aTHA+ORIF	62 ± 13	66 ± 17	69 ± 17	60 ± 14	66 ± 12	78 ± 16	78 ± 22	83 ± 21	41.1 ± 5	54.8 ± 7
Weaver *et al.* (29)										
ORIF	35.8 (0.04)	35.4 (0.29)	39.4 (0.04)	47.0 (0.66)	50.7 (0.99)	44.7 (0.26)	43.8 (0.37)	55.0 (0.14)	34.8 (0.15)	54.7 (0.64)
aTHA+ORIF	40.8	41.1	48.4	48.9	50.6	50.6	49.0	48.5	42.9	52.5
Manson *et al.* (30)										
ORIF									42.4 ± 8.6	46.2 ± 11.9
aTHA+ORIF									45.3 ± 8.9	45.6 ± 12.9

*mean (range); †*n*=14; ‡*n*=11.Phy. Func., physical function; Role Phy., role physical ; Gen., general; Soc. Fun., social function; MH, mental health; PCS, physical component summary; MCS, mental component summary.

Study name	MH risk ratio	Lower limit	Upper limit	p-Value	ORIF	aTHA	Relative weight
	Statistics for each study				Events / Total		
Lannes 2020	1.040	0.462	2.342	0.925	8 / 25	8 / 26	18.15
Weaver 2018	1.602	0.689	3.726	0.274	10 / 33	7 / 37	17.84
Carta 2017	8.065	2.719	23.921	0.000	25 / 31	3 / 30	15.53
Boelch 2017	2.152	0.590	7.855	0.246	11 / 23	2 / 9	13.67
Manson 2022	7.386	1.869	29.185	0.004	13 / 22	2 / 25	13.00
Lont 2019	6.800	1.631	28.349	0.008	10 / 25	2 / 34	12.57
Borg 2019	9.286	1.372	62.832	0.022	10 / 14	1 / 13	9.24
	3.411	1.610	7.227	0.001	87 / 173	25 / 174	

Heterogeneity: Q = 17.277, df = 6 (P = 0.008); I² = 65.272%

Test for overall effect: Z = 3.203 (P = 0.001)

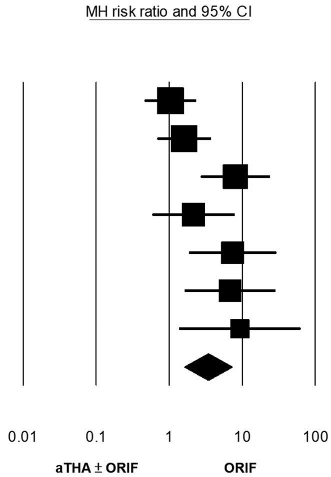

Figure 9
Forest plot of the risk ratio of complication rate comparing ORIF alone to aTHA ± ORIF.

is to achieve a stable construction rather than a truly anatomical restoration. This strategy helps limit the need for extensive operative exposure (14). The other major issue concerning ORIF is restriction on weight bearing with which some elderlies fail to comply (41). The prolonged restricted weight bearing strategy gave rise to immobilization and associated risk of pneumonia, deep vein thrombosis, permanent loss of mobility, and mortality rate up to 70% (41, 42, 43).

The total complication rate accounted for 50.3% in ORIF group in our study, while 39.4% patients underwent reoperation. Among those who underwent reoperation after treating ORIF alone, 92% patients required secondary (delay) THA. Conversion rate to secondary THR after ORIF failure in acetabular fractured elderlies is high. 19.4% (10)–54% (44) older patients with acetabular ORIF underwent delay THA, compared to 36.2% (range from 16% to 64%) in our included studies. On the other hand, other authors have disputed that the fracture pattern/quality of reduction influences the need for conversion to a THA. The authors who favored late intervention of THA argued that stability and secure fixation of the fracture is compromised when attempting a simultaneous hip arthroplasty (10, 34). Scarce studies compare outcomes between aTHA and delay THA in the acetabular fractured elderlies. The comparison between the two groups was depicted in Lont 2019 (28) and Carroll 2010 (23). Higher score of physical component summary in SF-36 was found significantly better in aTHA compared to delay THA. Nevertheless, 1-year Oxford Hip Score between two groups seemed insignificant ($P=0.4$). On the other hand, Nicol *et al.* (38) showed no significant difference operative time, length of stay, radiographic assessments between aTHA with ORIF and delay THA with ORIF in the acetabular fractured elderlies. However, better Oxford Hip Score was found in aTHA with ORIF ($P=0.03$).

aTHA bypasses the need for anatomic acetabular reduction and strict non-weight-bearing instructions (38) but brings about complications such as dislocation (7% in our included studies) or prosthetic component loosening (22). aTHA may be considered under two main circumstances: complications caused by osteosynthesis are too frequent to overweight its own benefits and the underlying joint degeneration which requires prosthetization to resolve both acetabular fracture and arthritis (24).

Tidemark *et al.* implanted Burch–Schneider anti-protrusion cages in aTHA for acetabular fractures with an intact posterior column (45). No signs of loosening and capability to walk independently were observed in all 4-year-follow-up patients (46). Inspired by Tidemark, Boelch *et al.* (22) conducted combined THA for those posterior column unstable patients by posterior column bridge plating before implanting the Bruch–Schneider anti-protrusion cage and prosthesis (22). Increasing studies (23, 27, 28, 39, 47, 48) support the use of only posterior plating in combination of THA, resulting in easier surgical approach, less operation times, simplified rehabilitation, and less complications. Posterior column plating was enough to stabilize the pelvis as a result of no revisions or complications due to instability were observed in studies. Therefore, it is crucial to stabilize posterior column and avoid central migration by using posterior column plate and anti-protrusion cage during surgery (28).

Bone grafting with the use of Burch–Schneider anti-protrusion cage and cemented cup was reported to have satisfactory results in osteoporotic acetabular fractured elderlies treated with primary THA. There were no deep infections (49, 50) nor loosening of acetabular components (49, 50, 51) with all bone grafts well incorporated (49, 50, 51) in a 26~48 months follow-up period (49, 50, 51). The average HHS and the EQ-5D index score ranged 85~88, (50, 51) and 0.62~0.65, (50, 51), respectively. Dislocation of the prosthesis was found in 2 patients with high risk for dislocation

Study name	MH risk ratio	Lower limit	Upper limit	p-Value	ORIF	aTHA	Relative weight
Weaver 2018	2.242	0.854	5.889	0.101	10 / 33	5 / 37	29.06
Carroll 2010	2.017	0.575	7.077	0.273	26 / 58	2 / 9	17.20
Boelch 2017	2.455	0.645	9.337	0.188	6 / 11	2 / 9	15.18
Manson 2022	5.682	1.393	23.178	0.015	10 / 22	2 / 25	13.71
Lannes 2020	2.600	0.555	12.191	0.226	5 / 25	2 / 26	11.35
Lont 2019	12.240	1.656	90.479	0.014	9 / 25	1 / 34	6.77
Borg 2019	19.600	1.263	304.137	0.033	10 / 14	0 / 13	3.60
Folsch 2015	6.818	0.362	128.327	0.200	2 / 10	0 / 14	3.14
	3.239	1.925	5.451	0.000	78 / 198	14 / 167	

(Statistics for each study; Events / Total)

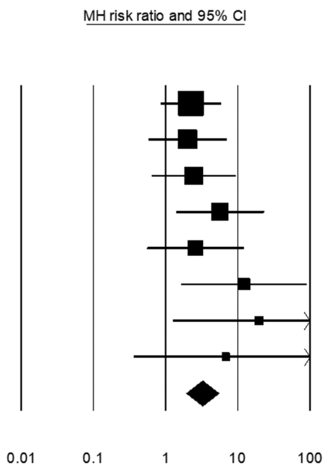

Figure 10
Forest plot of the risk ratio of reoperation rate comparing ORIF alone to aTHA ± ORIF.

(alcohol abuse and cognitive dysfunction) in Tidermark *et al.* study (51). Otherwise, no dislocation was noted in those low risk patients (49, 50, 51). However, heterotopic ossification (brooker I-III) was noted in 4 patients in two studies (50, 51).

In our included studies that applied bone grafts, anti-protrusion cages and cemented cups (16, 22, 27, 28), patients with high risk for dislocation were not particularly excluded. Dislocations were noted in two patients in Lannes 2020 (27) (one early, and one delay dislocation due to a fall), while twopatients suffered from early deep infections. Eight postoperative heterotopic ossifications were peculiarly noted in Borg 2019 (16), probably due to frequent use of posterior approach and torn gluteus minimus muscle not routinely resected. Otherwise, no evident difference found between aTHA ± ORIF and ORIF alone group.

Placement of acetabular component into comminuted fracture acetabulum can be challenging. Weaver *et al.* (29) proposed the use of fluoroscopic guidance under this circumstance. It was crucial that the position of C-arm matched the preoperative anteroposterior radiograph. Otherwise, slightly tilting of C-arm might result in cup malposition.

Surgical approaches reviewed in the included articles were similar between ORIF group and aTHA ± ORIF group for the fixation technique. Anterior approach (Ilioinguinal approach) or Anterior intrapelvic approach (modified Stoppa approach) was largely adapted if anterior column was involved and Posterior approach (Kocher–Langenbeck approach) was adapted for posterior column involved. For the replacement technique, posterior approach or direct lateral approach (Transgluteal Bauer approach) was mainly adapted. The need for ORIF is dependent on fracture morphology and THA is rather on surgeon's preference. Together, aTHA and ORIF can be realized as a combined approach. Therefore, in the approach option for aTHA + ORIF, posterior approach was suitable for posterior column fracture; on the other hand, for the anterior column fracture type, ORIF with anterior approach or anterior intrapelvic approach then aTHA with posterior approach or direct lateral approach was more commonly adapted.

In a literature review done by Clement *et al.* (52) which suggested that the overall re-operation risk is lower for cemented fixation in primary THA. Unless cross-linked polyethylene liners or alternative bearings can prove to yield superior outcome in the future, the cemented polyethylene cup remains the gold standard, in all age groups, by which every acetabular component should be compared. In these included studies, the cups were mainly cemented by 10~15 degrees anteversion

Study name	MH risk ratio	Lower limit	Upper limit	p-Value	ORIF	aTHA	Relative weight
Weaver 2018	0.623	0.232	1.672	0.347	5 / 33	9 / 37	59.98
Lont 2019	0.880	0.089	8.719	0.913	2 / 25	1 / 11	11.12
Lannes 2020	1.040	0.069	15.739	0.977	1 / 25	1 / 26	7.92
Carta 2017	0.968	0.063	14.779	0.981	1 / 31	1 / 30	7.87
Borg 2019	0.133	0.008	2.357	0.169	0 / 14	3 / 13	7.09
Boelch 2017	1.250	0.056	28.151	0.888	1 / 23	0 / 9	6.03
	0.652	0.304	1.402	0.274	10 / 151	15 / 126	

(Statistics for each study; Events / Total)

Heterogeneity: Q =1.639, df = 5 (P = 0.896); I² = 0%

Test for overall effect: Z = -1.094 (P = 0.274)

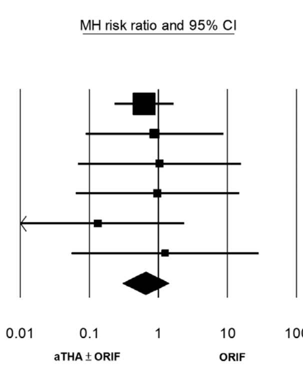

Figure 11
Forest plot of the risk ratio of Mortality rate comparing ORIF alone to aTHA ± ORIF.

and 30~40 degrees inclination as to prevent prothesis dislocation (22, 24); meanwhile, whether the stems need to be cemented depends on the bone quality of the patient.

Van Praet *et al.* (53) also advocated in a systemic review the use cemented acetabulum cup, irrespective of age or technique. They suggested cemented prostheses (cemented stem with cemented cup) had a similar or lower risk of revision compared to hybrid prostheses (cemented stem with uncemented cup), but performed slightly worse on functionality and quality of life. While cemented prostheses were the cheapest option, and hybrids were the most cost-effective.

aTHA using uncemented acetabular revision cup has become increasingly popular. Becker *et al.* (54) demonstrated good results using cementless acetabular cup in geriatric acetabular fractures, with Barthel index score of 80.0 and a mean HHS of 72.0. The benefit of using cementless cup is the avoidance of cement-associated complications such as delayed revascularization or bone cell necrosis (55). Furthermore, it reduced the risk of bone injury in the case of cup revision and cement removal (56). To date, most discussions of cementless cups were limited to post-traumatic osteoarthritis patients rather than elderly patients with acetabular fractures. In our included studies, the use of cementless acetabular components were not mentioned. More studies are still needed to prove the efficacy of cementless cups in aTHA for acetabular fractures elderlies.

For the choice of the acetabular component, a network meta-analysis (57) with 77 included studies demonstrated that newer implant combinations, defined by bearing surface materials (metal-on-polyethylene, ceramic-on-polyethylene, ceramic-on-ceramic, or metal-on-metal), head size (large ≥36 mm or small <36 mm), and fixation technique (cemented, uncemented, hybrid, or reverse hybrid) were not found to be better than the reference implant combination (metal-on-polyethylene (not highly cross linked), small head, cemented) in terms of risk of revision surgery or HHS. Metal-on-metal, small head, cemented implants, and resurfacing increased the risk of revision surgery compared with the reference implant combination.

The high heterogeneity observed in outcomes might derive from various covariates.

Incongruous distribution among different types of acetabular fractures, different injury severity and different approaches presumably gave rise to heterogeneity in each study. The discrepant surgery time and blood loss in Lont 2019 (28) compared to other included studies mainly arose from easier approach in aTHA group which contained plate fixation of posterior column only, leading to shorter surgery time and lesser blood loss compared to ORIF alone group. The high heterogeneity in complication rate might arose from early collection (postoperative 6 weeks) of complication data in Lannes 2020 (27), while other studies collected throughout the entire follow-up period. Other than disparate follow-up periods, different postoperative rehabilitation protocols, fracture patterns, surgeons' preferences, and severity of comorbidities among patients might as well attribute to the discrepancy of clinical outcomes among studies.

There were several limitations in this study. First, follow-up period among most studies variates and some of which followed less than 1 year. There were several outcomes and complications which required longer and unanimous follow-up period to obtain accurate results and, therefore, became inaccurate. Second, studies we included were nearly all retrospective cohort studies but one prospective clinical trial (30), all with small sample size, and from which data we extracted was raw data without adjustment, leading our analysis to bear various biases and low statistical power. Third, different fracture patterns and procedures adapted among the included studies inevitably gave rise to misclassification bias in both groups.

Conclusion

In summary, this systemic review and meta-analysis demonstrated that aTHA with limited ORIF provided higher HHS, better physical function, physical component summary, and mental component summary but greater bodily pain in postoperative 1-year SF-36, and yielded lesser complication and reoperation rate in acetabular fractured elderlies compared to ORIF alone. For those who are unable to comply with restriction on weight bearing, who bear higher risk of anatomic reduction failure, postoperative complications, and arthritis by performing ORIF, it is favorable to treat acetabular fractured elderlies with aTHA. However, further prospective trials or randomized control trials are required to better illustrate the optimal surgical decision for this procedure.

Supplementary materials

This is linked to the online version of the paper at https://doi.org/10.1530/EOR-21-0099.

ICMJE conflict of interest statement

The authors declare that there is no conflict of interest that could be perceivedas prejudicing the impartiality of the research reported.

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