

Acetabular Erosion After Bipolar Hip Hemiarthroplasty: A Systematic Review

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Abstract

Background

Bipolar hemiarthroplasty is the most common procedure performed for femoral neck fractures, providing pain relief and early mobilization. However, a bipolar prosthesis may result in acetabular erosion in long-term studies.

Purpose

This study aimed to assess the incidence of acetabular erosion after bipolar hip hemiarthroplasty and the risk factors associated with it.

Patients & Methods

We searched Web of Science, PubMed, Scopus, and Cochrane databases for relevant randomized clinical trials (RCTs) and observational studies that reported advanced acetabular erosion after bipolar hemiarthroplasty. Data were extracted from eligible studies and pooled as raw (untransformed) proportions (PR) or mean difference (MD) with corresponding 95% confidence intervals (CI) using open-meta[analyst] software for Windows.

Results

A total of 32 studies were included (13 RCTs and 18 observational studies, 1 non-comparative intervention study). Analyses included 2797 patients with a mean age of 66 years and a mean follow-up time of 24.6 months. The overall pooled estimates showed that acetabular erosion incidence was 1.4% (95% CI 1%– 1.8%), acetabular erosion grades was 0.8 (95% CI 0.58– 0.102) and incidence of reoperation due to acetabular erosion was 1.4% (95% CI 0.5%– 2.4%). The incidence of acetabular erosion increase in patients <60 years old or patients with BMI ≥ 24 or who underwent cementless bipolar hemiarthroplasty with femoral head size ≥ 48 .

Conclusion

acetabular erosion incidence was 1.4% (95% CI 1%– 1.8%) and the risk factors for acetabular erosion were age (<60 years old), BMI (≥ 24), femoral head size (≥ 48), and bipolar hemiarthroplasty using the cementless implant.

Keywords

Bipolar hemiarthroplasty, femur neck fractures, acetabular erosion.

Introduction

Femoral neck fractures are one of the devastating injuries in old age. The global incidence of hip fractures in the year 2000 has been estimated at 1.6 million and the projections for the future suggest further increasing numbers [1]. Management of displaced intracapsular hip fracture in the elderly remains controversial. Options include hemiarthroplasty or total hip arthroplasty [2]

Hemiarthroplasty is one of the commonest procedures done for femoral neck fractures. It provides pain relief and early mobilization [3]. Bipolar hemiarthroplasty was found to be very useful and results were encouraging. However, in the long term studies show that the bipolar prosthesis leads to some erosion. However, not all patients with acetabular erosions were

symptomatic [4].

A previous meta-analysis study conducted by imam et al., (2019) [5] found that bipolar hemiarthroplasty is associated with a better range of motion, lower rates of acetabular erosion and lower reoperation rates compared to the unipolar hemiarthroplasty but at the expense of longer operative time. However, there was no previous meta-analysis that revealed the incidence of acetabular erosion in patients who underwent bipolar hemiarthroplasty with different demographic criteria and the factors giving rise to the incidence of acetabular erosion in patients who underwent bipolar hemiarthroplasty. To rectify this, we operated a meta-analysis study to assess the incidence of acetabular erosion after bipolar hip hemiarthroplasty and the risk factors associated with it.

Patients and Methods

This systematic review and meta-analysis were conducted following the PRISMA (Preferred Reporting Items for Systematic Reviews and MetaAnalyses) guidelines [6].

Literature search: The literature search was performed in the Web of Science, PubMed, Scopus, and Cochrane databases from 2000 till 2021, using the following search strategy: (((Hemiarthroplast* OR Hemi Arthroplasty OR Hemi-Arthroplast *OR Prosthesis* OR Prosthetic OR endoprosthesis) AND bipolar) OR (femoral neck fractures OR hip fractures)) AND “acetabular erosion”. The search was limited to English-language publications. The reference lists of all relevant articles were also hand-screened for additional articles. Any discrepancies between reviewers were resolved through consensus.

Eligibility criteria: Studies were selected if they met the following criteria: (1) full-text observational studies or interventional studies which reported the incidence of acetabular erosion after bipolar hemiarthroplasty. (2) Publications from the year 2000 till 2021. Animal studies, case reports, case series, review articles, and studies performed in pregnant or lactating women and abstract only were excluded.

Studies selection: The search results will be screened independently by the authors using titles of papers and abstracts. After the relevant studies will be identified, the full publication will be retrieved and reviewed independently by the authors to determine suitability for final inclusion.

Quality assessment and data extraction: The quality of all included studies was assessed using the Newcastle Ottawa Scale for cohort and case-control studies and the Cochran risk of bias tool for randomized clinical trials [7].

Data extraction: The authors also will be extracted data from the included studies by using a standard data extraction form. The following data will be extracted baseline characters and summary of included studies as location and design of the study; first author’s name; journal and year of publication; age and sex of participants; disease status of participants; the number of acetabular erosion patients and so on.

Statistical analysis

All statistical analyses were done with an open-meta[analyst] program using raw (ie, untransformed) proportions to calculate the pooled estimates of proportions with corresponding 95% CIs. Both the fixed-effects and the random-effects models were taken into account. We used the I² statistic to evaluate heterogeneity among the studies [8].

Results

Demographics and characteristics

We identified 2388 published papers, 32 of which were found relevant and then included in this study (figure 1). The included studies consisted of 2797 patients which included only 313 (11%) patients with acetabular erosion. Studies were operated into 12 countries most of them were in India (8 studies). There were different study designs RCT (13 studies), cohort studies (15 studies), case-control studies (3 studies), and non-comparative intervention study (1 study). In the majority of studies, implant type was cemented (in 21 studies), cementless in 2 studies, and the 2 types in 6 studies. Follow-up periods among different studies range from months to more than 20 years. In the majority of studies, The acetabular erosion assessment had been operated by Standard anteroposterior pelvis and lateral hip radiographs. In the majority of studies, the population was patients with femoral neck fractures who underwent hemiarthroplasty. Most studies included elderly patients (age range from 60 to 80 years). In ten papers mean BMI ranged from 23 to 28. (Table 1).

Quality assessment:

Observational studies (cohort studies and case-control studies) achieved a mean of 7 out of 9 points on the Newcastle–Ottawa quality assessment scale (NOS) indicating a moderate quality (table 2 and table 3). 75% of RCT were at low risk of bias regarding random sequence generation and incomplete outcome data and selective reporting. 25% of RCT were at low risk of bias regarding blinding of participants and personal. Ten out of 13 RCT achieved adequate random sequence generation, six trials described allocation concealment and five kept unbroken blinding (figure 2).

Table 1: summary of included studies

author	country	Study design	Sample size	Number of acetabular erosion in BHA	Type of implant	Assessment of acetabular erosion	Factors affecting acetabular erosion	Follow up periods (years)
Abdelkhalek 2011 [9]	Egypt	RCT	50	2	The 2 types			4.4
Bauer 2010[10]	Australia	prospective cohort studies	303, UHA 206, BHA 97	2	cemented			6
Davison 2001[11]	England	RCT	280, UHA 90, BHA 97	1	cemented			5
Dennis 2015[12]	Singapore	cohort study	270; UHA 164 BHA 106	0	cemented	Standard anteroposterior pelvis and lateral hip radiographs		4.25
Diwanji 2008[13]	Korea	non-comparative intervention study	25	17	cemented	Standard anteroposterior pelvis and lateral hip radiographs		3
Enocson 2011[14]	Sweden	prospective cohort study	830; UHA 427, BHA 403	2	cemented	Standard anteroposterior pelvis and lateral hip radiographs		3.1
avery 2011[15]	United Kingdom	prospective cohort study	81, (HA) 41	8	cemented	Standard anteroposterior pelvis and lateral hip radiographs		9
BAKER 2006[16]	United Kingdom	RCT	41	21	cemented	Standard anteroposterior pelvis and lateral hip radiographs		3
Haidukewych 2001 [17]	united states	prospective cohort study	205	15	cemented			11.7
Hedbeck 2011[18]	Sweden	RCT	120	2	cemented	Standard radiographs	acetabular erosion occurred more frequently among patients with BMI <24 kg/m ²	1
Houdek 2019[19]	canada	retrospective cohort study	148	52	The 2 types	magnification-corrected supine AP plain radiographs using templating software		7.5
Hsu 2019[20]	Taiwan	case-control study	48	7	cementless			5.3
Iamthanaporn 2018 [21]	Thailand	case-control study	133; (UHA) 51, (BHA) 82	6	The 2 types			
inngul2013 [22]	Sweden	RCT	120; UHA 60, BHA 60	13		radiological and graded by grading system		4
Somashekar, 2013 [23]	india	RCT	41; UHA 20, BHA 21	0	cementless			
MOORTHY 2014 [4]	india	retrospective cohort study	22	6	cemented		erosion increases as the duration increases	3.54
Naser 2018[24]	india	RCT	140 ; UHA 70, BHA 70	0				1
Naveen 2018[25]	india	RCT	100 ; UHA 50, BHA 50	0		radiologically		1
Rubio 2020[26]	Spain	prospective cohort study	135; UHA 73, BHA 60	2	cementless			10
Rushi 2015 [27]	india	RCT	60; UHA30, BHA 30	2	cemented			2
Schiavi 2018 [28]	italy	prospective cohort study	209	57	cemented		clinical score (OHS, WS),BMI and the size of the femoral head	10
Seyfettinoğlu 2018 [29]	Turkey	prospective cohort study	48	0.12±0.05 (grade)	cemented	Standard radiographs		2.3
theil 2019[30]	Germany	cohort study	112	32	The 2 types	Standard radiographs	acetabular erosion significantly increased in patients less than 40 years of age	5
Venkatash 2018 [31]	India	cohort study	22	6	cemented	radiological and graded by grading system	acetabular erosion significantly increased in patients less than 40 years of age	3.54
Vishwanath 2017 [32]	India	RCT	102 , UHA 50, BHA 52	0	cemented			1
Zacharia 2018 [33]	India	RCT	48 , UHA 29, BHA 19	0	cemented			8 months
Moniz 2018 [34]	Australia	case-control study	31, BHA 16 THR 15	19				
Leonardsson 2012 [35]	Sweden	prospective cohort study	23509	12	The 2 types			6
kanto2014 [36]	Finland	RCT	175 ; UHA 88 BHA 87	2	cemented	Standard radiographs		7.2
Von Roth 2015 [37]	Germany	prospective cohort study	376	2	cemented	Standard radiographs		24
Cadossi 2013 [38]	italy	RCT	49	1	The 2 types	Standard radiographs		2.5
Moon 2021 [39]	Korea	cohort study	114	45	The 2 types	Standard radiographs	the acetabular erosion group showed significantly younger age at the time of surgery, higher body mass index (BMI), more avascular necrosis of the femoral head	13.8

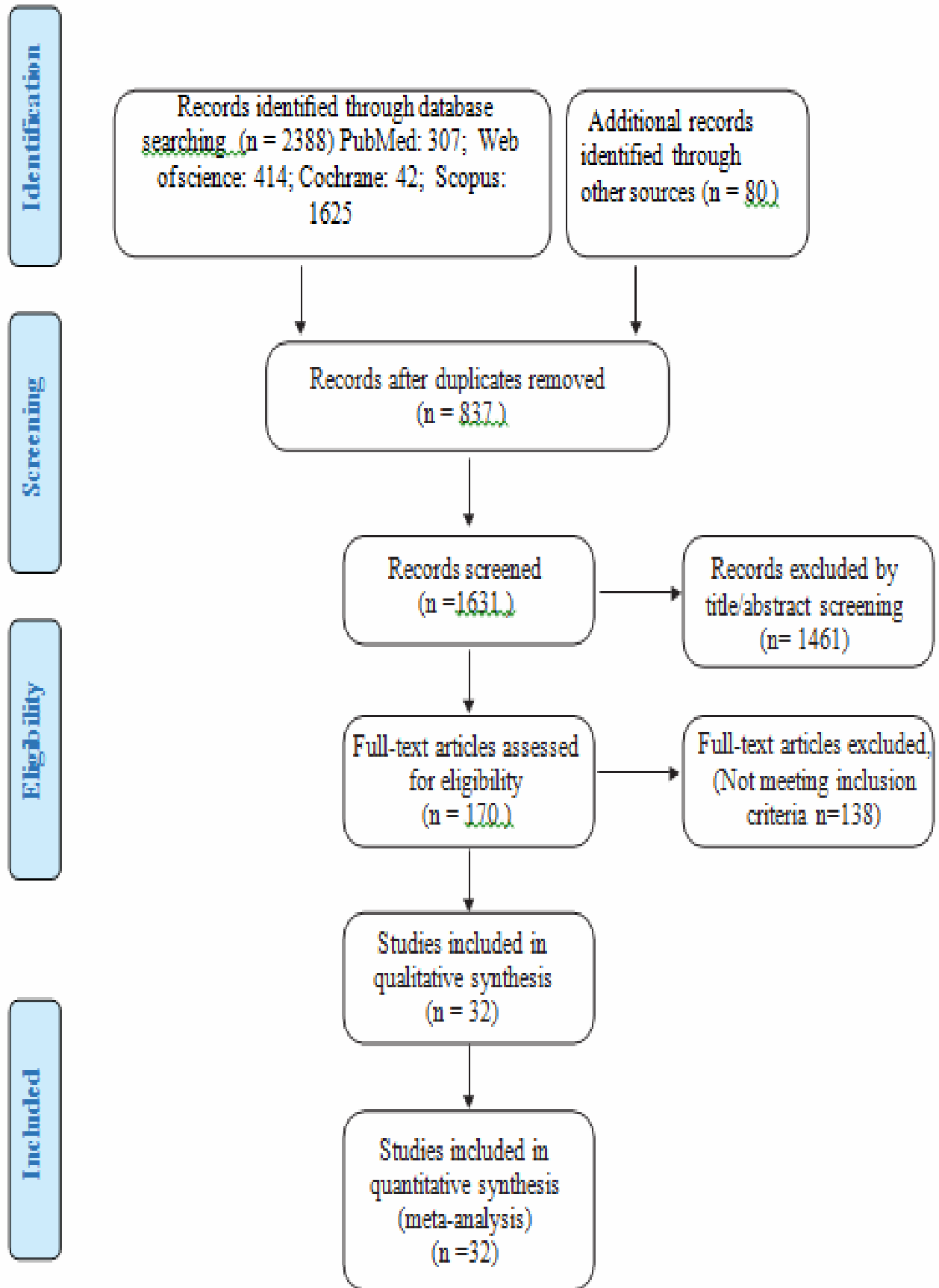


Figure 1. PRISMA Flowchart of the literature search and study selection process

Outcomes

The overall incidence of acetabular erosion among patients underwent bipolar hemiarthroplasty 1.4% (95% CI 1%– 1.8%; I2 = 0%, P < 0.001) without any evidence of heterogeneity (figure 3). The incidence of acetabular erosion among patients underwent bipolar hemiarthroplasty was higher in patients less than 60 years (22.9% (95% CI 19.3 %– 22.6%; I2 = 0%)) than patients

60:80 years (1.2% (95% CI 0.7 %– 1.8%; I2 = 0%)) or more than 80 years old 1% (95% CI 0.4

%– 1.7%; I2 = 0%). There were no evidence of heterogeneity (figure 4).

Regarding of BMI, The incidence of acetabular erosion among patients underwent bipolar hemiarthroplasty was higher in patients with BMI more than or equal 24 (27% (95% CI 23 %– 31%; I2 = 0%)) than in patients with BMI less than 24 (8.6% (95% CI 6.4 %– 10.9 %; I2 = 0%)) without evidence of heterogeneity (figure 5). Regarding of prosthesis head size, The incidence of acetabular erosion among patients underwent bipolar hemiarthroplasty was higher in patients more than or equal 48 (17.6% (95% CI 11 %– 24.1%; I2 = 0%)) than in patients less than 48 (11.2%

(95% CI 2 %– 20 %; I2 = 0%)) without evidence of heterogeneity. The incidence of acetabular erosion among patients underwent bipolar hemiarthroplasty with prosthesis head size range 44mm-72mm was (35.4% (95% CI 12.5 %– 58%; I2 = 96.3%)) and 38mm-60 mm

was (2.8% (95% CI 0.2 %– 5.8%; I2 = 96.5%)) with high heterogeneity (figure 6).

Regarding of implant type, The incidence of acetabular erosion among patients underwent bipolar hemiarthroplasty was higher in the 2 types (cemented and cementless) (14.5% (95% CI 11.7 %– 17.2%; I2 = 0%)) than cemented implant (1% (95% CI 0.6 %– 1.4%; I2 = 0%)) and

cementless implant (4.9% (95% CI 1.9 %– 8%; I2 = 0%)) without heterogeneity (figure 7). The overall acetabular erosion grades among patients underwent bipolar hemiarthroplasty was 0.8 (95% CI 0.58– 0.102; I2 = 0%) without any evidence of heterogeneity (figure 8). The overall

incidence of reoperation due to acetabular erosion was 1.4% (95% CI 0.5%– 2.4%; I2 = 0%)

without any evidence of heterogeneity (figure 9).

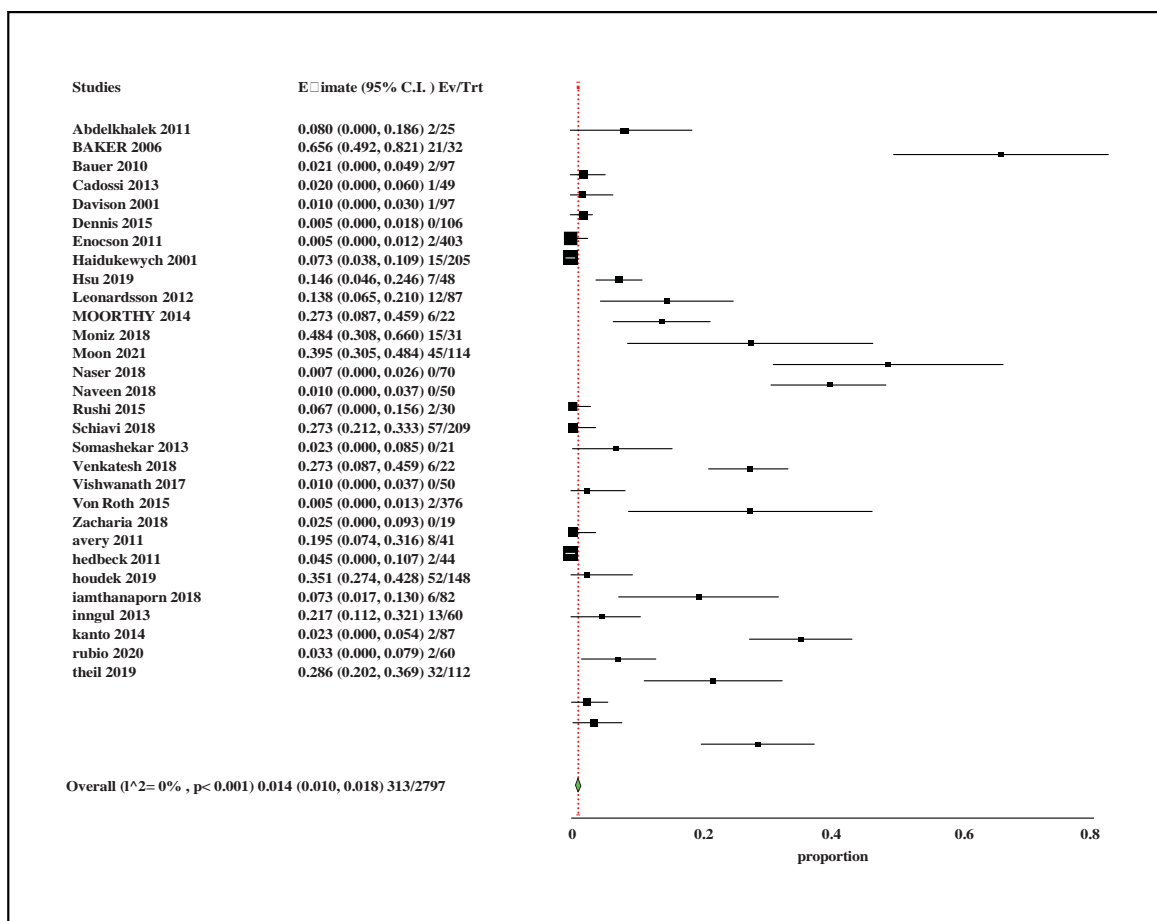


Figure 3: Forest plot of acetabular erosion

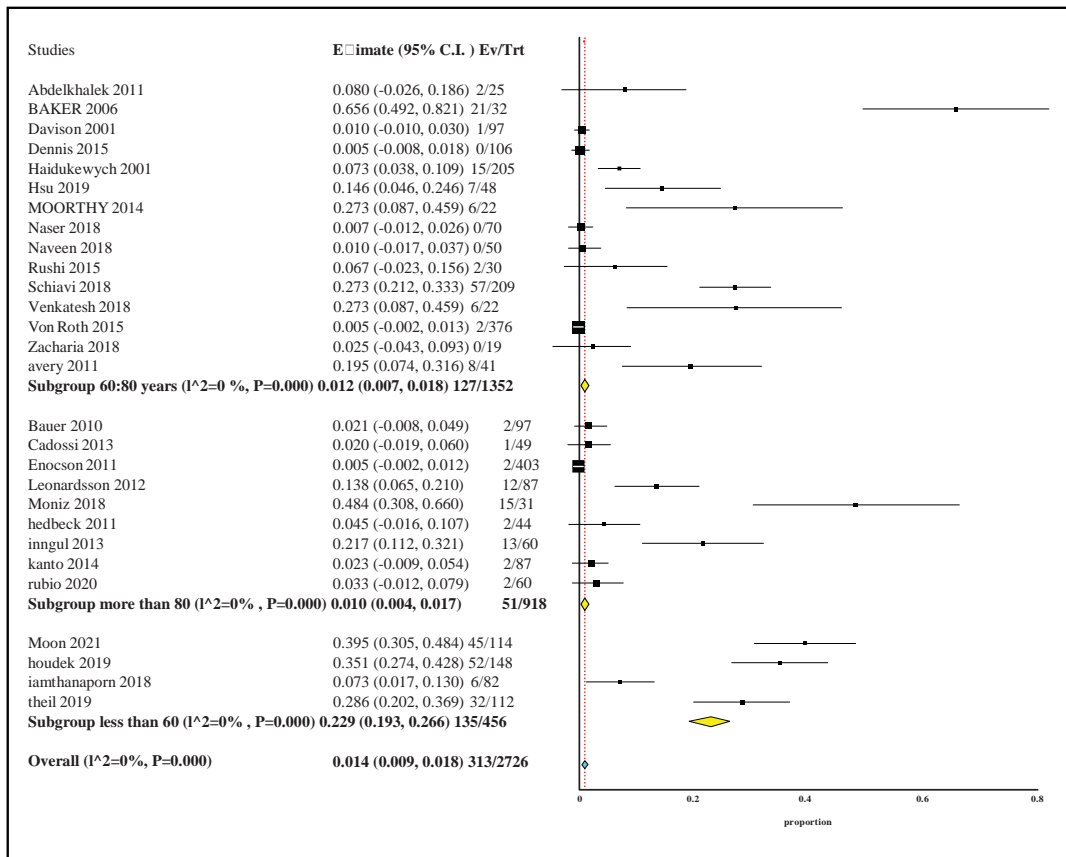


Figure 4: Forest plot of acetabular erosion with different age

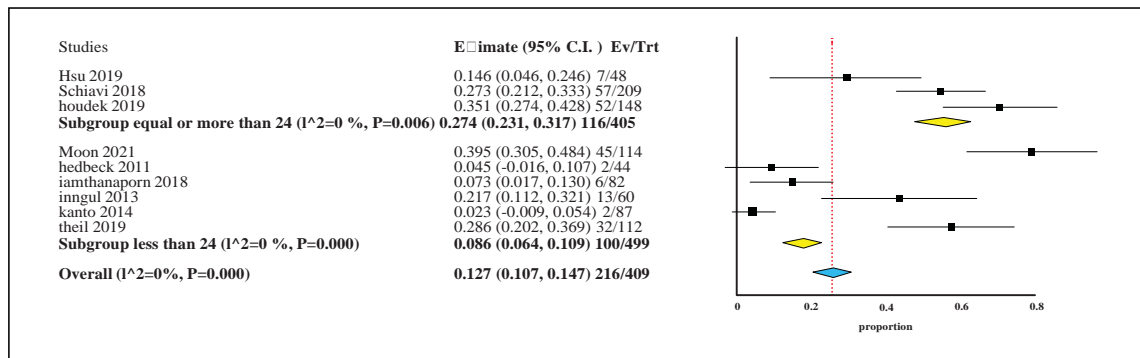


Figure 5: Forest plot of acetabular erosion with different BMI

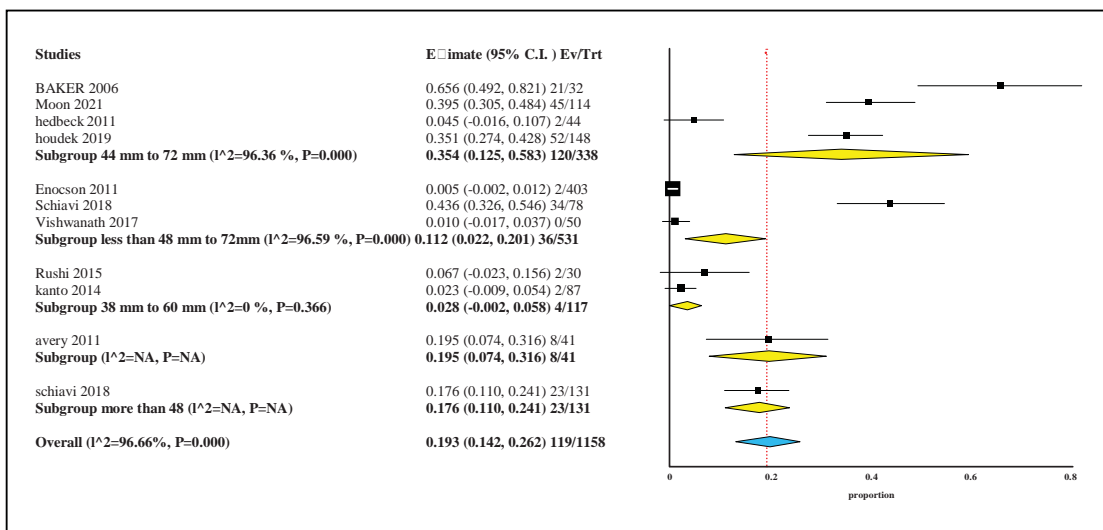


Figure 6: Forest plot of acetabular erosion with different prosthesis head size

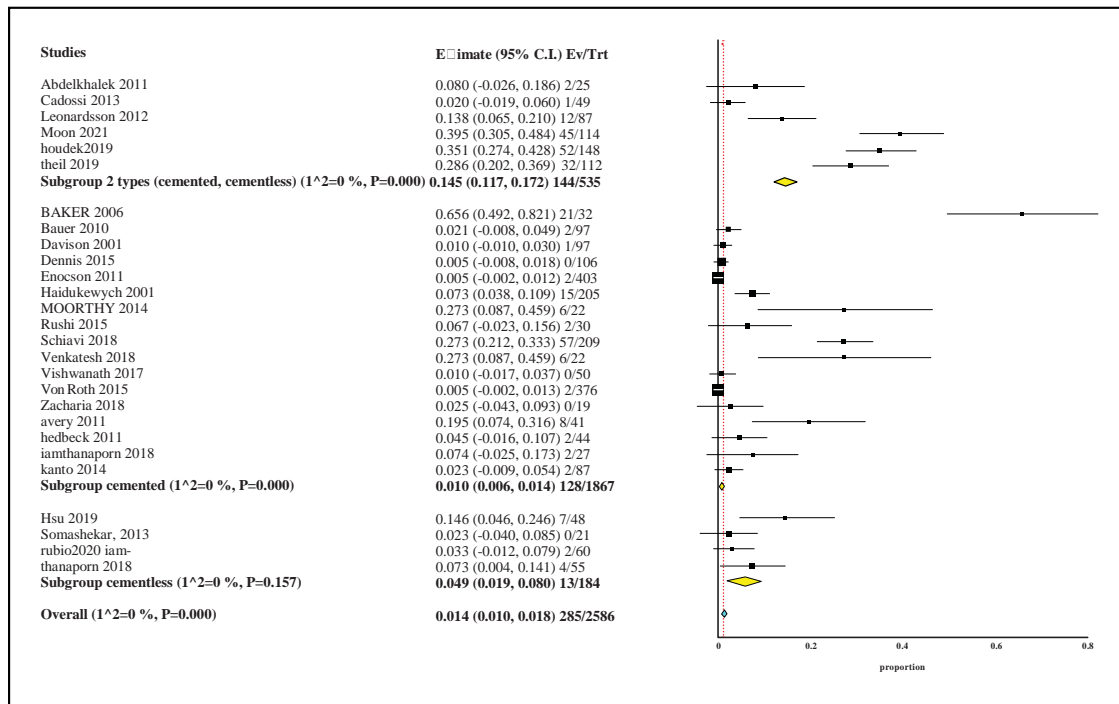


Figure 7: Forest plot of acetabular erosion with a different type of implant

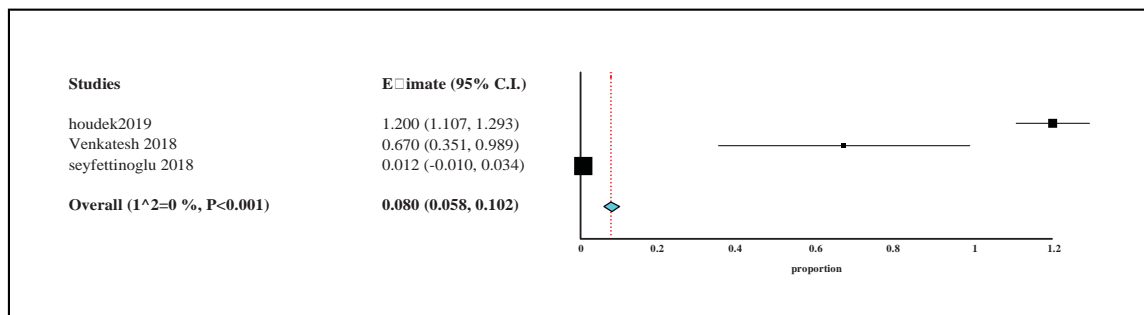


Figure 8: Forest plot of acetabular erosion grades

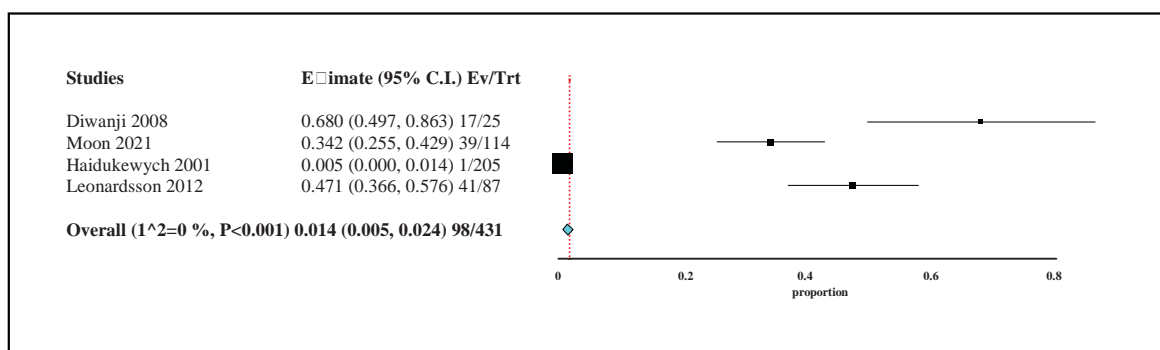


Figure 9: Forest plot of incidence of reoperation due to acetabular erosion

Discussion

Incidence of fracture femoral neck is increasing gradually, probably due to increase in life expectancy of individuals. The ideal treatment is still controversial. Two common procedures done for elderly people are hemiarthroplasty and total hip arthroplasty [40].

More than two-thirds of all days spent in hospital for a fracture are owed to hip fractures [41]. The choice of treatment and outcome assessment in elderly patients is contentious because of their limited life expectancy. This makes early satisfaction as important as long-term outcomes [42]. With annual mortality of 30% and associated substantial impairment of inde-

pendence and quality of life, the treatment goal for hip fractures is to return to pre-injury mobility status as early as possible [43]. No previous meta-analysis has shown the proportion of patients who advanced acetabular erosion after bipolar arthroplasty, so this meta-analysis study was performed.

Our meta-analysis study investigated that the overall incidence of acetabular erosion among patients underwent bipolar hemiarthroplasty 1.4% (95% CI 1%–1.8%; I2 = 0%, P < 0.001).

Abdelkhalik et al., (2011) [9] found that acetabular erosion and joint space narrowing were found in 4% of the bipolar group. Moreover, in **Baker et al., (2006) [16]**, twenty-one of thirty-two living patients in the hemiarthroplasty group had radiographic evidence of acetabular erosion at the time of the final follow-up (3 years) . While in **Bauer et al., (2010) [10]**, two patients out of 97 patients who underwent bipolar hemiarthroplasty had acetabular erosion 0.02%.

The most important findings of our meta-analysis is that incidence of acetabular erosion increase in patients lower than 60 years old, with BMI equal or more than 24, who underwent cementless bipolar hemiarthroplasty with femoral head size more than or equal 48.

Theil C et al., (2019) [30] revealed that acetabular erosion significantly increased in patients less than 40 years of age. This may be justified by the difference in mobility status between elderly and younger patients. It is well established that the prevalence of functional limitations and disability is associated with aging. For example, 31.7% of adults aged 65 years and older report difficulty in walking 3 city blocks; only 11.3% of adults aged 45 to 64 years have similar difficulty. Another study reported that 20% of adults aged 65 years and older do not drive a motor vehicle. At least 4 public health burdens are associated with limited or restricted mobility in older populations [44].

Moon et al., (2021) [39] revealed that the acetabular erosion group showed significantly younger age at the time of surgery, higher body mass index (BMI), more avascular necrosis of the femoral head. **Moon et al., (2021) [39]** found that the mean head size of the BHA prosthesis used in surgery was 46.0 mm in group 1 (no acetabular erosion) was smaller than that used in group 2 (acetabular erosion) (p < 0.001). Following **Iamthanaporn et al., (2018) [21]** who reported that the number of cemented with acetabular erosion was 2 form (27) and the number of cementless with acetabular erosion was 4 form (55). In the meta-analysis study, The overall acetabular erosion grades

among patients underwent bipolar hemiarthroplasty was 0.8 (95% CI 0.58– 0.102; I2 = 0%). The acetabular erosion grades are varied between included studies 1.2 ± 0.58 [19] and 0.12 ± 0.05 [29].

The overall incidence of reoperation due to acetabular erosion was 1.4% (95% CI 0.5%– 2.4%; I2 = 0%). **Moon et al., (2021) [39]** revealed that the survival rate when the endpoint was reoperation related to acetabular erosion was found to be significantly time-dependent: 73.2 % at 5 years, 48.8 % at 10 years, and 25.9 % at 15 years. **Diwanji et al., (2008) [13]** reported that indications for conversion included acetabular erosion (25 patients) with the well-fixed femoral stem in 13 patients, acetabular erosion with femoral loosening in 8 patients, and periprosthetic fracture in 4 patients.

Conclusion

Our pooled estimate revealed the following:

- The overall incidence of acetabular erosion among patients who underwent bipolar hemiarthroplasty was 1.4% (95% CI 1%– 1.8%)
- The incidence of acetabular erosion increase in patients lower than 60 years old, with BMI equal or more than 24, who underwent cementless bipolar hemiarthroplasty with femoral head size more than or equal 48
- Variance in acetabular erosion incidence was reported among different follow-up periods, countries, and study designs.
- The overall acetabular erosion grades among patients who underwent bipolar hemiarthroplasty were 0.8 (95% CI 0.58– 0.102)
- The overall incidence of reoperation due to acetabular erosion was 1.4% (95% CI 0.5%–2.4%).
- Other complications of bipolar hemiarthroplasty include: (acetabular fracture was 0.3%, Acetabular protrusion was 0.6% and Acetabular dislocation 1.1%, femoral stem loosening 1.4%, Hetero topic ossification was 4.3% and Periprosthetic fracture was 0.4%.

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