

3 REVIEW ARTICLE

4 Internal fixation versus arthroplasty for
5 hip fracture in patients with dementia or
6 cognitive impairment: a systematic review
7 and meta-analysis

Abdulaziz Abdullah Alqahtani^{1*} , Ahmad Ghaleb Kadhimi², Albaraa Mansour
Alamoudi³, Nawaf Ahmed Alghamdi⁴, Abdulaziz Alhassan Khamjan⁵, Sultan
Fahad Alomari⁶, Razan Afit Alshammari⁷, Mohammed Ahmed Almagali⁸,
Mubarak Mohammed Alshahrani⁸, Saeed Salim Alrumaih¹, Ghazi Alqahtani⁹

8 ABSTRACT

9 **Background:** Hip fractures in patients with dementia or cognitive impairment are associated with increased
10 morbidity, mortality, complications, and functional decline. Arthroplasty is generally preferred to internal
11 fixation (IF) in older adults with a displaced femoral neck fracture, but the optimal strategy in this population
12 remains uncertain because of frailty, limited rehabilitation potential, and the frequent exclusion of patients
13 with dementia from comparative trials. We compared the outcomes of IF and arthroplasty after hip fracture
14 surgery in patients with dementia or cognitive impairment.

15 **Methods:** PubMed/MEDLINE, Web of Science, and Google Scholar were searched from inception to July 2026
16 for comparative studies of IF, hemiarthroplasty, or total hip arthroplasty in patients with dementia or cognitive
17 impairment who sustained a hip fracture. Randomized, quasi-randomized, and observational studies were
18 eligible. Studies comparing two arthroplasty constructs were analyzed separately from IF versus arthroplasty
19 comparisons. Dichotomous outcomes were pooled as risk ratios (RRs) using Mantel–Haenszel fixed-effect
20 models and continuous outcomes as mean differences (MDs) using inverse-variance random-effects models,
21 with 95% confidence intervals (CIs) and, where estimable, 95% prediction intervals (PIs). Certainty of evidence
22 was rated with Grading of Recommendations Assessment, Development and Evaluation. The protocol was
23 prospectively registered in PROSPERO (CRD420261468833).

24 **Results:** Eight studies were included. Six enrolled patients with displaced femoral neck fracture exclusively;
25 two registry or claims cohorts covered hip fracture more broadly. One quasi-randomized trial compared two
26 arthroplasty constructs and was analyzed separately. In the IF versus arthroplasty comparisons, operative time
27 was numerically shorter with IF, but the difference was not significant (MD –29.41 minutes, 95% CI –110.82
28 to 52.01; $I^2 = 78.6\%$; two trials). Reoperation or revision was more frequent after IF (RR 3.36, 95% CI 1.33 to
29 8.48; $I^2 = 0\%$; two trials). Mortality was higher after IF before one year (RR 1.20, 95% CI 1.07 to 1.36), at one
30 year (RR 1.23, 95% CI 1.16 to 1.29), and at two years (RR 1.21, 95% CI 1.14 to 1.28), with $I^2 = 0\%$ throughout;
31 the prediction interval excluded the null value of 1 at one and two years but not at the short-term landmark.
32 The EQ-5D index at 12 months did not differ significantly between strategies (MD –0.07, 95% CI –0.25 to 0.10).
33 Certainty of evidence was very low for all outcomes.

34 **Conclusions:** In patients with dementia or cognitive impairment, arthroplasty was associated with fewer reop-
35 erations and lower mortality than IF, although the reoperation estimate rests on two small trials and differ-
36 ences in health-related quality of life remained uncertain. Given the very low certainty of the evidence, the
37 surgical choice should be individualized according to fracture characteristics, frailty, functional status, and
38 instability risk.

39 **Keywords:** Hip fracture, arthroplasty, internal fixation, dementia, cognitive impairment, meta-analysis.



40 Introduction

41 Hip fracture is a major injury in older adults and a
42 leading contributor to death, loss of mobility, and loss of
43 independence; its burden is expected to rise as populations
44 age. Outcomes are consistently worse when dementia
45 is present, because cognitive impairment is associated
46 with poorer functional recovery, more postoperative
47 complications, delirium, and higher mortality after
48 hip fracture [1–3]. Population-based data also indicate
49 that, among people with dementia and a femoral head
50 or neck fracture, surgical treatment is associated with
51 lower short- and intermediate-term mortality than non-
52 operative management when surgery is consistent with
53 the patient's goals of care [2].

54 Which operation to perform remains uncertain. In older
55 adults with a displaced femoral neck fracture, guidelines
56 recommend arthroplasty over internal fixation (IF),
57 and evidence from the general older population shows
58 substantially fewer reoperations after arthroplasty [3,4].
59 Arthroplasty removes the dependence on fracture healing
60 and permits early weight bearing, but it carries risks of
61 dislocation and other implant-related complications. Total
62 hip arthroplasty (THA) may offer functional advantages
63 in selected patients, whereas hemiarthroplasty (HA)
64 may carry a lower risk of dislocation [3]. In dementia,
65 the decision is further shaped by baseline mobility,
66 life expectancy, the ability to observe postoperative
67 precautions, and rehabilitation potential [5,6].

68 Randomized trials and observational studies have
69 compared IF, HA, and THA in older adults, but most of
70 this evidence is not specific to dementia, and patients with
71 cognitive impairment are frequently excluded from or
72 underrepresented in hip fracture trials [7]. The dementia-
73 specific evidence is dispersed across small trials, registry
74 analyses, and subgroup reports, which makes treatment
75 effects difficult to estimate. We therefore conducted a
76 systematic review and meta-analysis comparing IF with
77 arthroplasty for hip fracture in patients with dementia
78 or cognitive impairment, with mortality, reoperation or
79 revision, operative time, dislocation, and health-related
80 quality of life as outcomes.

81 Methods

82 Protocol and registration

83 The protocol for this systematic review and meta-
84 analysis was prospectively registered in PROSPERO
85 (CRD420261468833). The review was conducted and
86 reported in accordance with the Preferred Reporting
87 Items for Systematic Reviews and Meta-Analyses
88 (PRISMA) 2020 statement [8] and the methodological
89 guidance of the Cochrane Handbook for Systematic
90 Reviews of Interventions [9].

91 Data sources and search strategy

92 We searched PubMed/MEDLINE, Web of Science, and
93 Google Scholar from database inception to July 2026.
94 The search combined three concept blocks with the
95 Boolean operator AND, using OR within each block:
96 the injury (femoral neck fracture, hip fracture, and

Correspondence to: Abdulaziz Abdullah Alqahtani

*Primary Affiliation: College of Medicine, King Khalid
University, Abha, Saudi Arabia.

Email: AzAAAlqahtani@hotmail.com

Full list of author information is available at the end of
the article.

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intracapsular fracture terms); the population (dementia, 97
cognitive dysfunction, cognitive impairment, Alzheimer 98
disease, and delirium terms); and the intervention (IF, 99
fracture fixation, cannulated screw, sliding hip screw, 100
HA, unipolar and bipolar HA, THA, hip replacement, 101
and dual-mobility terms). No language, publication-date, 102
or study design filter was applied, so that randomized 103
and non-randomized comparative studies were both 104
retrievable. We also screened the reference lists of eligible 105
studies and of relevant reviews to identify additional 106
reports. The complete, verbatim search strategy for 107
each database, together with the search dates, any limits 108
applied, and the number of records retrieved, is provided 109
in Supplementary Table 1. 110

Eligibility criteria 111

We included comparative studies of operative treatment 112
for hip fracture in adults with dementia or cognitive 113
impairment. Eligible studies compared IF with HA or 114
THA, or compared eligible arthroplasty procedures 115
directly. Outcomes for patients with dementia or 116
cognitive impairment had to be reported separately from 117
those of cognitively intact participants, or be derivable 118
from the published data. We considered randomized 119
controlled trials, quasi-randomized trials, prospective 120
and retrospective cohort studies, and registry- or claims- 121
based comparative studies. Each study had to report at 122
least one outcome of interest: operative time, reoperation 123
or revision, dislocation, mortality, or health-related 124
quality of life. 125

Most eligible studies enrolled patients with a displaced 126
femoral neck fracture. Registry and claims cohorts 127
reporting hip fracture more broadly were also eligible, 128
provided that dementia-specific comparative outcomes 129
were available; the fracture patterns covered by each 130
study are specified in Table 1, and the implications of 131
this mixing are addressed in the Limitations. 132

We excluded studies in which dementia-specific data 133
could not be separated, in which no eligible surgical 134
comparator was available, or in which the analysis 135
was restricted to predictors, prognostic factors, or risk 136
factors without a comparative treatment effect. Studies 137
of cognitively intact participants only were excluded, 138
as were reviews, editorials, letters, case reports, 139
conference abstracts with insufficient outcome data, 140
and duplicate or overlapping datasets. Where several 141
reports described overlapping populations, we retained 142
the most complete or methodologically appropriate 143
report for the relevant analysis. 144

Table 1. Characteristics of the included studies.

Study / country	Design	Population	Comparison	Sample	Age	Follow-up
Iorio et al. [18] Italy	Quasi-randomized trial	Dementia; displaced FNF	Bipolar HA versus dual-mobility THA	60 (30/30)	83 versus 82 years	≥1 year
Blomfeldt et al. [14] Sweden	RCT	Severe cognitive impairment; displaced FNF	IF versus uncemented HA	60 (30/30)	83.6 versus 84.0 years	4, 12, 24 months
Hedbeck et al. [16] Sweden	RCT	Severe cognitive dysfunction; displaced FNF	IF versus cemented HA	60 randomized; 59 analyzed	83.8 versus 85.2 years	4, 12, 24 months
Johansson et al. [19] Sweden	RCT (Zelen design)	Displaced FNF; cognitive-impairment subgroup (termed mental dysfunction in the original report)	IF versus THA	100 overall; subgroup 45 (20/25)	84 years overall	3 months, 1 and 2 years
Gjertsen et al. [15] Norway	Prospective registry cohort	Displaced FNF; cognitive subgroup of responders	IF versus bipolar HA	4,335 overall; subgroup 110 (48/62)	85.5 versus 83.1 years	4 and 12 months
Kristoffersen et al. [20] Norway	Prospective registry cohort	Hip fractures; cognitive impairment subgroup	Osteosynthesis/ HA characteristics; contextual	87,573 overall; 23,729 impaired	85.5 years impaired	Mean 1.8 years impaired
Ioannidis et al. [17] Sweden	Retrospective registry cohort with PSM	Dementia; displaced FNF	Pins/screws versus HA	9,394 (1,469/7,925)	84 versus 85 years	30 days and 1 year
Lai et al. [21] Taiwan	Retrospective claims cohort	Dementia hip-fracture subgroup; fracture type mixed	IF versus HA	8,080 (4,875/3,205)	65 years or older	In-hospital, 3 months, 1 and 2 years

Abbreviations: FNF, femoral neck fracture; HA, hemiarthroplasty; IF, internal fixation; PSM, propensity-score matching; RCT, randomized controlled trial; THA, total hip arthroplasty. Iorio 2019 compared two arthroplasty constructs and contributed only to the hemiarthroplasty versus dual-mobility total hip arthroplasty comparison; Johansson 2000 and Kristoffersen 2020 did not contribute to any pooled analysis.

Study selection

All retrieved records were compiled and deduplicated before screening. Reviewers independently screened titles and abstracts, then assessed full texts against the prespecified eligibility criteria. Studies meeting the criteria entered the qualitative synthesis and, where outcome data were sufficiently comparable, the quantitative synthesis. Disagreements were resolved by discussion and consensus, with adjudication by an additional reviewer where necessary.

Data extraction and outcome definitions

Data were extracted independently using a standardized, piloted extraction sheet. For each study we recorded the design, country, study period, sample size, participant characteristics, definition of dementia or cognitive impairment, fracture characteristics, treatment groups, and follow-up duration. Intervention details included the type of IF and, for arthroplasty, whether unipolar or bipolar HA, conventional THA, or dual-mobility THA was performed. Dichotomous outcomes were extracted as events and totals per treatment arm, and continuous outcomes as means and standard deviations per arm; where necessary, summary statistics were derived from the reported data using established methods [10]. Discrepancies were resolved by consensus.

The primary outcomes were postoperative mortality, reoperation or revision, and operative time. Mortality was analyzed at three prespecified follow-up landmarks, each treated as a separate outcome. Short-term mortality was defined as death occurring before 12 months and was taken from the earliest mortality time point reported by each study (in-hospital, 30 days, three months, or four months). One-year mortality was defined as cumulative

death at 12 months, and two-year mortality as cumulative death at 24 months. Each study contributed at most one estimate to any single analysis, and no study contributed two different time points to the same pooled estimate. Because the one-year and two-year outcomes are cumulative incidences, they are reported as distinct follow-up landmarks rather than as mutually exclusive intervals. Secondary outcomes were dislocation and health-related quality of life measured with the EQ-5D index at 12 months.

Risk of bias and certainty of evidence

Risk of bias was assessed independently and according to study design. Randomized and quasi-randomized studies were evaluated with the Cochrane Risk-of-Bias 2 (RoB 2) tool, covering the randomization process, deviations from intended interventions, missing outcome data, outcome measurement, and selection of the reported result [11]; studies were rated as low risk, some concerns, or high risk. Non-randomized comparative studies were assessed with the Risk Of Bias In Non-randomized Studies of Interventions (ROBINS-I) tool [12], covering confounding, participant selection, classification of interventions, deviations from intended interventions, missing data, outcome measurement, and selection of the reported result; overall risk was rated as low, moderate, serious, or critical.

Certainty of evidence for each principal outcome was rated with the Grading of Recommendations Assessment, Development and Evaluation (GRADE) approach [13] across the domains of risk of bias, inconsistency, indirectness, imprecision, and publication bias, and categorized as high, moderate, low, or very low. Disagreements in risk-of-bias or GRADE judgements were resolved by discussion and consensus.

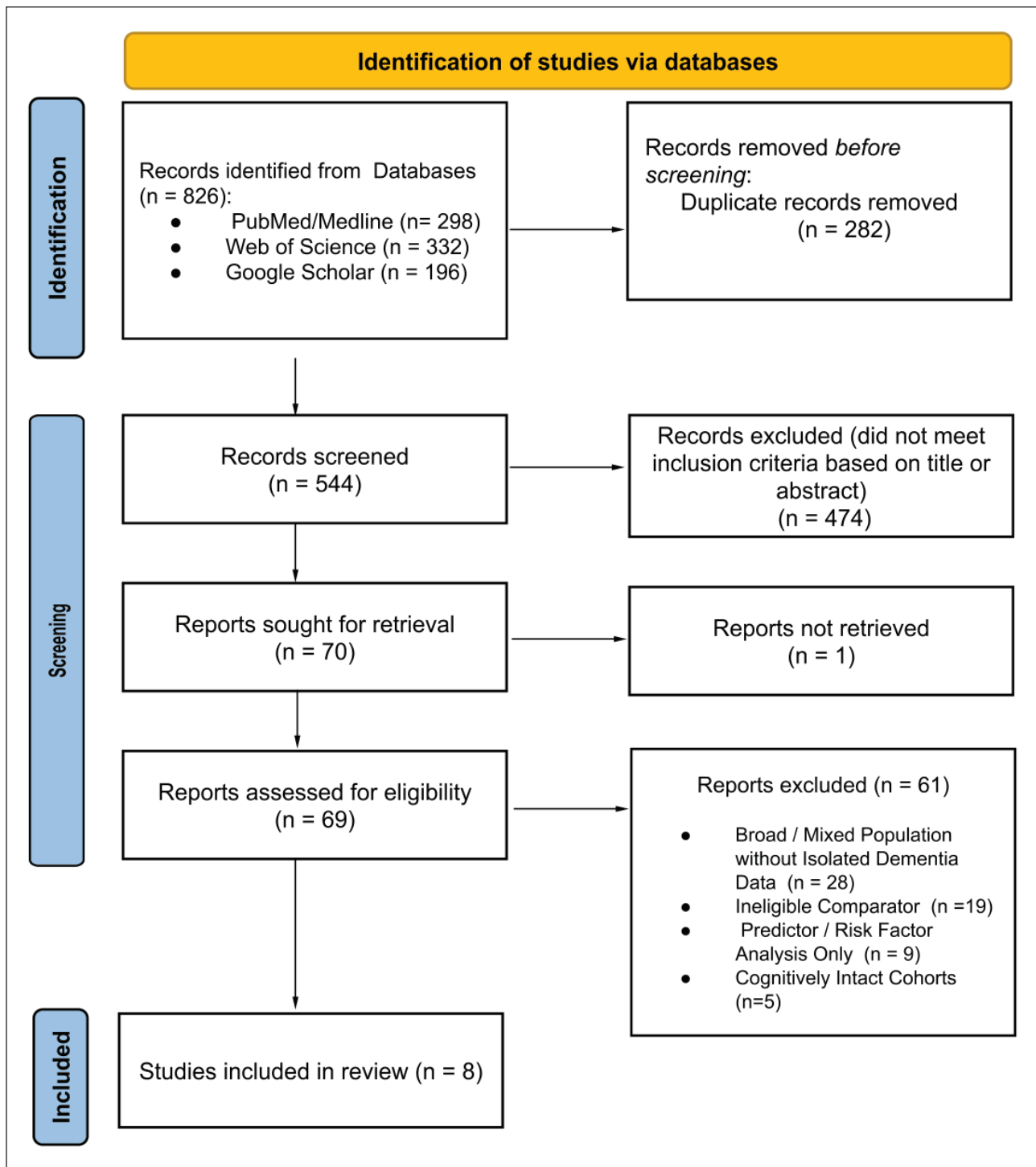


Figure 1. Study selection flow diagram.

Statistical analysis

Analyses were performed in R version 4.3.3. Dichotomous outcomes (mortality, reoperation, or revision, and dislocation) were summarized as risk ratios (RRs) with 95% CIs, and continuous outcomes measured on a common scale (operative time and the EQ-5D index) as mean differences (MDs) with 95% CI. Studies were pooled only when their populations, interventions, comparators, outcome definitions, and follow-up periods were judged sufficiently comparable on clinical and methodological grounds. Studies comparing two arthroplasty constructs

with each other were not combined with IF versus arthroplasty comparisons; they were analyzed separately, so that each pooled estimate contrasts a single pair of interventions. Dichotomous outcomes were pooled with Mantel–Haenszel fixed-effect models and continuous outcomes with inverse-variance random-effects models. Statistical heterogeneity was quantified with the I^2 statistic and the between-study variance τ^2 . Where the number of contributing studies allowed a stable estimate, 95% PIs were calculated to describe the range of effects expected in a future comparable study; PIs were not

A. Randomized and quasi-randomized studies (RoB 2)								
Study	D1	D2	D3	D4	D5	Overall		
Iorio 2019	-	+	+	+	?	-		
Blomfeldt 2005	+	+	+	+	?	?		
Hedbeck 2013	+	+	+	+	?	?		
Johansson 2000	-	-	?	?	?	-		
B. Non-randomized studies (ROBINS-I)								
Study	D1	D2	D3	D4	D5	D6	D7	Overall
Gjertsen 2010	-	-	?	+	-	?	?	-
Kristoffersen 2020	-	+	?	+	?	+	?	-
Ioannidis 2022	-	?	+	+	?	+	?	-
Lai 2018	-	?	?	+	+	?	?	-
Judgments: + Low ? Some concerns / Moderate - High / Serious - Critical								
RoB 2: D1 randomization; D2 deviations; D3 missing data; D4 outcome measurement; D5 selective reporting. ROBINS-I: D1 confounding; D2 selection; D3 intervention classification; D4 deviations; D5 missing data; D6 outcome measurement; D7 selective reporting.								

Figure 2. Risk-of-bias summary for randomized or quasi-randomized (A) and non-randomized (B) studies.

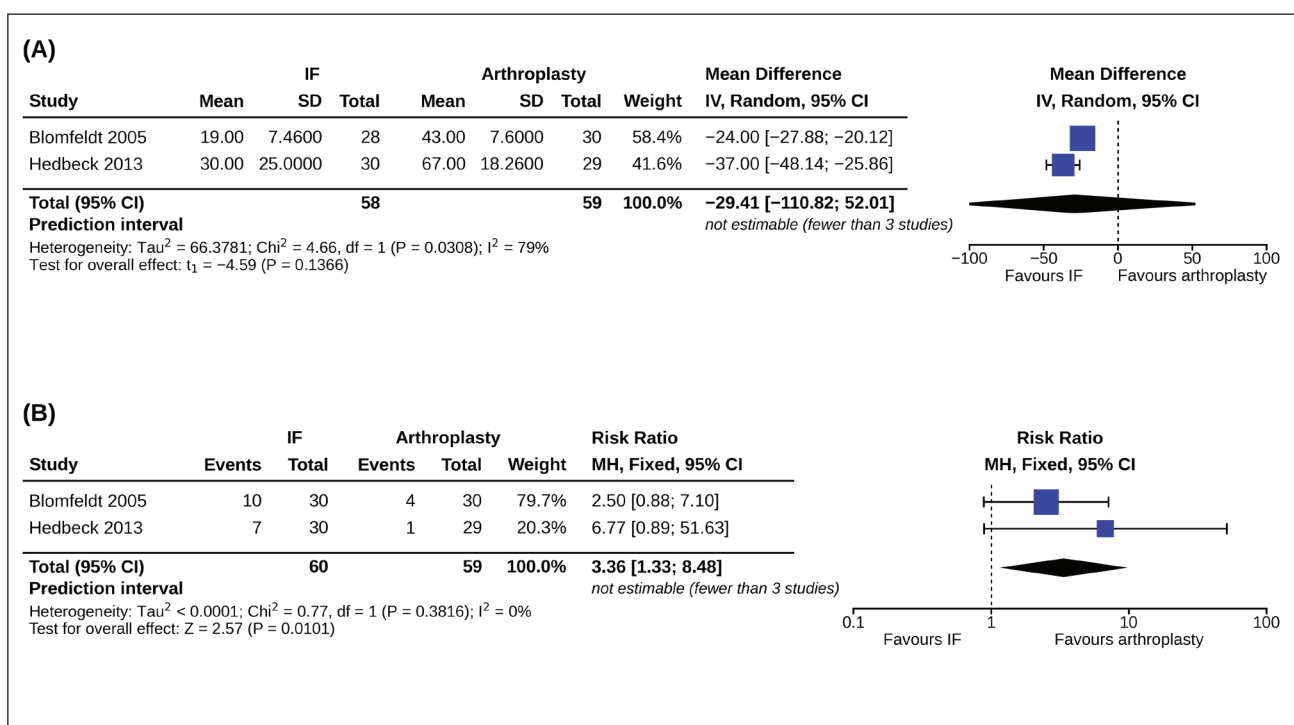


Figure 3. Forest plots for operative time in minutes (A) and reoperation or revision (B).

237	estimated when too few studies were available. For risk	and Hedbeck et al. raised some concerns (Figure 2A).	293
238	ratios, the null value is one, and for MDs it is 0. Statistical	Among the non-randomized studies, those by Gjertsen	294
239	significance was defined as a two-sided <i>p</i> -value below	et al., Kristoffersen et al., and Ioannidis et al. were at	295
240	0.05.	serious overall risk and that by Lai et al. at critical risk,	296
		driven principally by confounding, treatment selection,	297
241	Results	incomplete responder data, and mixing of fracture	298
		patterns (Figure 2B). On GRADE assessment, certainty	299
242	Literature search	of evidence was very low for every outcome, reflecting	300
		serious to very serious risk of bias, indirectness, and	301
243	The database searches identified 826 records (PubMed/	imprecision (Table 2).	302
244	MEDLINE, 298; Web of Science, 332; Google Scholar,		
245	196). After removal of 282 duplicates, 544 records were		
246	screened and 474 were excluded on title and abstract.		
247	Seventy reports were sought for full-text review, of		
248	which one could not be retrieved. Of the 69 full texts		
249	assessed, 61 were excluded because dementia-specific		
250	data could not be isolated (<i>n</i> = 28), the comparator		
251	was ineligible (<i>n</i> = 19), the report was a predictor or		
252	risk-factor analysis only (<i>n</i> = 9), or the population		
253	was cognitively intact (<i>n</i> = 5). Eight studies met the		
254	inclusion criteria [14-21] (Figure 1).		
		Operative time and reoperation or revision	303
255	Characteristics of included studies		
		Two randomized trials reported operative time in	304
256	The eight included studies were published between	patients undergoing IF or arthroplasty. The operation was	305
257	2000 and 2022 and were conducted in Sweden (four),	numerically shorter with IF, but the pooled difference	306
258	Norway (two), Italy (one), and Taiwan (one). Four were	was not statistically significant and the interval was very	307
259	randomized or quasi-randomized trials and four were	wide (MD -29.41 minutes, 95% CI -110.82 to 52.01; <i>I</i> ²	308
260	observational studies based on registry or claims data.	= 78.6%; Figure 3A). Both trials favored IF, by 24 and	309
261	Sample sizes ranged from 60 participants in the smaller	37 minutes, respectively, but with only two studies the	310
262	trials to 87,573 hip fracture records in the largest registry,	between-study variance could not be estimated reliably	311
263	from which only the dementia or cognitive impairment	and a prediction interval was not calculated. Reoperation	312
264	strata were extracted. Six studies enrolled patients	or revision was more frequent after IF in the same two	313
265	with a displaced femoral neck fracture exclusively;	trials (RR 3.36, 95% CI 1.33 to 8.48; <i>I</i> ² = 0%; Figure	314
266	the Norwegian hip fracture registry analysis covered	3B), corresponding to 17 of 60 patients after fixation and	315
267	hip fracture more broadly, and the Taiwanese claims	5 of 59 after arthroplasty. The direction of effect was	316
268	cohort included mixed fracture patterns that could not	consistent, but the CI was wide and spans a modest to a	317
269	be separated. Five studies compared IF with HA, one	very large difference.	318
270	compared IF with THA, one compared bipolar HA		
271	with dual-mobility THA, and one provided contextual		
272	treatment data. Follow-up ranged from in-hospital		
273	assessment to two years (Table 1).		
		Postoperative mortality	319
274	Because the interventions being contrasted differed, not		
275	every included study contributed to every synthesis.	Short-term mortality before 12 months was reported by	320
276	The trial of bipolar HA versus dual-mobility THA	four studies comprising 6,404 patients treated with IF and	321
277	compared two arthroplasty constructs rather than	11,189 treated with arthroplasty. Mortality was higher	322
278	fixation with arthroplasty and was therefore analyzed	after IF (RR 1.20, 95% CI 1.07 to 1.36; <i>I</i> ² = 0%; 95%	323
279	separately and excluded from all IF versus arthroplasty	PI 0.99 to 1.47; Figure 4A). The CI excluded the null	324
280	pooled estimates. The trial of IF versus THA and the	value of 1, but the prediction interval did not, so a future	325
281	Norwegian registry analysis did not report outcome	comparable study could plausibly show no difference at	326
282	data in a form that could be combined and contributed	this landmark. At one year, the same four studies showed	327
283	to the narrative synthesis only. The studies contributing	higher mortality after IF (RR 1.23, 95% CI 1.16 to 1.29;	328
284	to each pooled outcome are listed in Table 2 and shown	<i>I</i> ² = 0%; 95% PI 1.12 to 1.33; Figure 4B), with both the	329
285	in Figures 3-5.	CI and the prediction interval excluding 1. At two years,	330
		three studies comprising 4,935 patients treated with IF	331
		and 3,264 treated with arthroplasty showed a persistently	332
		higher mortality after IF (RR 1.21, 95% CI 1.14 to 1.28;	333
		<i>I</i> ² = 0%; 95% PI 1.06 to 1.37; Figure 4C), again with	334
		both intervals excluding 1. Statistical heterogeneity was	335
		absent at all three landmarks.	336
		Bipolar hemiarthroplasty versus dual-mobility	337
		total hip arthroplasty	338
286	Risk of bias and certainty of evidence		
		One quasi-randomized trial (<i>n</i> = 60) compared bipolar	339
287	Among the randomized and quasi-randomized studies,	HA with dual-mobility THA and was analyzed separately	340
288	the trials by Iorio et al. and Johansson et al. were judged to	from the IF comparisons. Dislocation was more frequent	341
289	be at high overall risk of bias, mainly because allocation	after bipolar HA, but events were very sparse and the	342
290	was predictable and because deviations from intended	estimate was correspondingly unstable (RR 11.00, 95%	343
291	interventions and the selection of reported results were	CI 0.63 to 190.56; risk difference 16.7%). Operative	344
292	insufficiently protected; the trials by Blomfeldt et al.	time was shorter with HA (50.3 vs. 59.3 minutes), and	345
		mortality did not differ appreciably at either the short-	346
		term or the one-year landmark. No pooled analysis	347
		was possible for this comparison, and the certainty of	348
		evidence was very low (Table 2).	349

Table 2. GRADE certainty-of-evidence profile.

Outcome / design	Effect	Risk of bias	Inconsistency	Indirectness	Imprecision	Publication bias	Certainty	Rationale
Dislocation, HA versus dual-mobility THA 1 quasi-randomized trial (n = 60)	RR 11.0 (95% CI 0.63 to 190.56); RD 16.7%	Very serious	Not applicable	Not serious	Very serious	Not assessable; one study	Very low	Alternate-admission allocation and extremely sparse events.
Reoperation/ revision, IF versus arthroplasty 2 randomized controlled trials (n = 119)	RR 3.36 (95% CI 1.33 to 8.48); I ² = 0%; 95% PI not estimable	Serious	Not serious	Not serious	Very serious	Not assessable; fewer than 10 studies	Very low	Both trials raised some concerns on risk-of-bias assessment; only 119 patients and 22 events contributed, and the confidence interval spans a modest to a very large effect.
Short-term mortality (before 1 year), IF versus arthroplasty 2 randomized controlled trials + 2 observational cohorts (n = 17,593)	RR 1.20 (95% CI 1.07 to 1.36); I ² = 0%; 95% PI 0.99 to 1.47	Very serious	Not serious	Serious	Serious	Not assessable; fewer than 10 studies	Very low	The estimate was dominated by observational evidence with serious to critical confounding risk; one claims cohort included mixed hip-fracture patterns, and the prediction interval crossed the null.
One-year mortality, IF versus arthroplasty 2 randomized controlled trials + 2 observational cohorts (n = 17,593)	RR 1.23 (95% CI 1.16 to 1.29); I ² = 0%; 95% PI 1.12 to 1.33	Very serious	Not serious	Serious	Not serious	Not assessable; fewer than 10 studies	Very low	Observational cohorts contributed most of the information and remained vulnerable to treatment selection and residual confounding; fracture patterns were mixed in Lai.
Two-year mortality, IF versus arthroplasty 2 RCTs + 1 claims cohort (n = 8,199)	RR 1.21 (95% CI 1.14 to 1.28); I ² = 0%; 95% PI 1.06 to 1.37	Very serious	Not serious	Serious	Not serious	Not assessable; fewer than 10 studies	Very low	The pooled estimate was overwhelmingly driven by the critical-risk claims cohort, in which fracture pattern was mixed and not separable.
EQ-5D index at 12 months, IF versus arthroplasty 2 RCTs + 1 registry subgroup (n = 179 responders)	MD -0.07 (95% CI -0.25 to 0.10); I ² = 15.1%; 95% PI -0.24 to 0.09	Very serious	Not serious	Serious	Very serious	Not assessable; fewer than 10 studies	Very low	Survivor/response bias and incomplete responder data limited confidence; the confidence and prediction intervals allowed clinically important effects in either direction.
Operative time, IF versus arthroplasty 2 randomized controlled trials (n = 117)	MD -29.41 minutes (95% CI -110.82 to 52.01); I ² = 78.6%; 95% PI not estimable	Serious	Very serious	Not serious	Very serious	Not assessable; fewer than 10 studies	Very low	Only two small trials contributed, heterogeneity was substantial, and the confidence interval was very wide and crossed the null.

Note: GRADE certainty categories are high, moderate, low, and very low. Publication bias was not formally assessable because each outcome included fewer than 10 studies. CI, confidence interval; HA, hemiarthroplasty; IF, internal fixation; MD, mean difference; PI, prediction interval; RCT, randomized controlled trial; RD, risk difference; RR, risk ratio; THA, total hip arthroplasty.

Health-related quality of life

Three studies reported the EQ-5D index at 12 months. The pooled estimate numerically favored arthroplasty, but the difference between strategies was not statistically significant (MD -0.07, 95% CI -0.25 to 0.10; I² = 15.1%; 95% PI -0.24 to 0.09; Figure 5). Statistical heterogeneity was low, but both the CI and the prediction

interval included the null value of 0. It therefore remains uncertain whether IF and arthroplasty differ in health-related quality of life at 12 months.

Discussion

In patients with dementia or cognitive impairment undergoing hip fracture surgery, IF was associated with

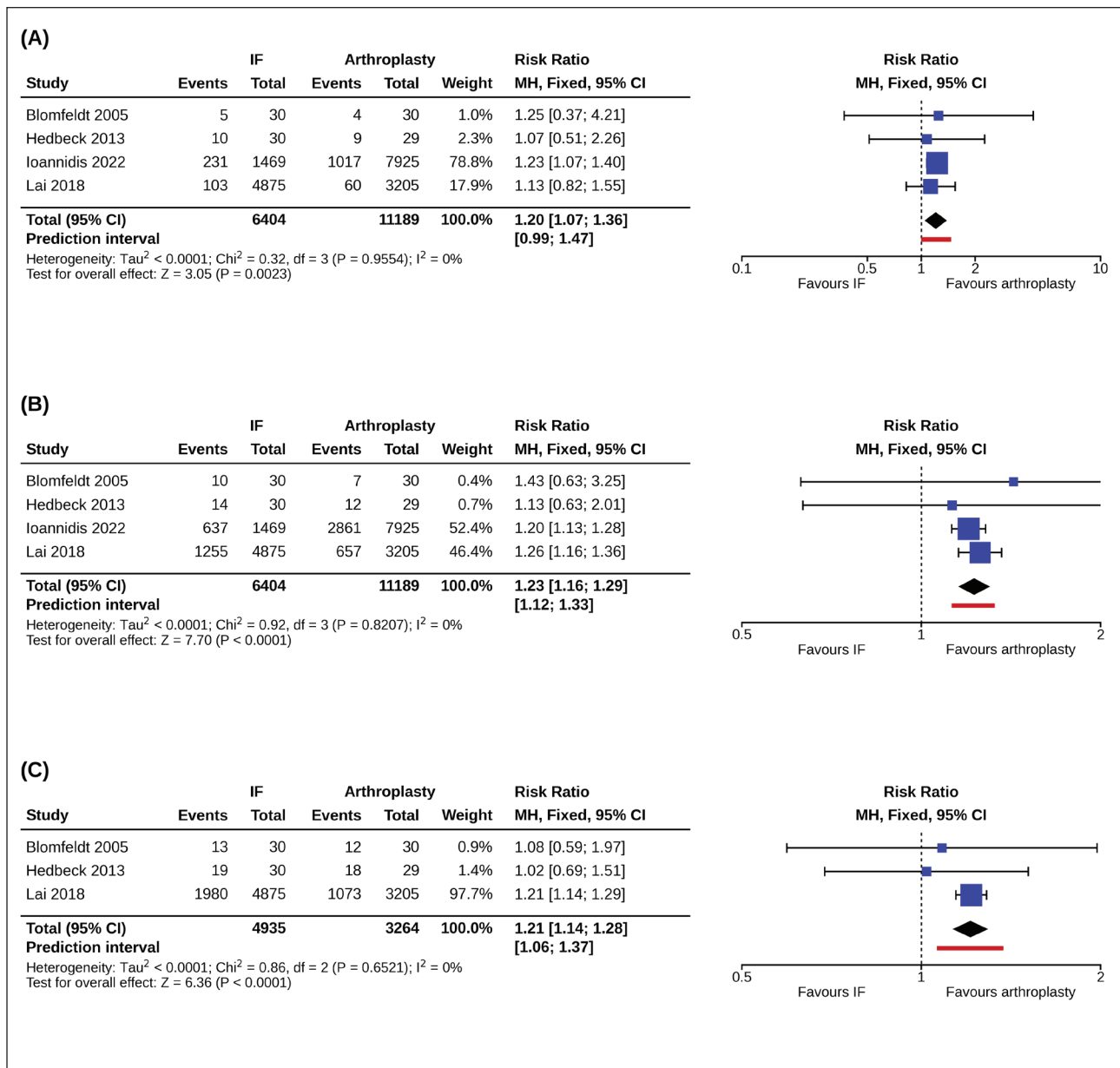


Figure 4. Forest plots for short-term (A), one-year (B), and two-year (C) mortality.

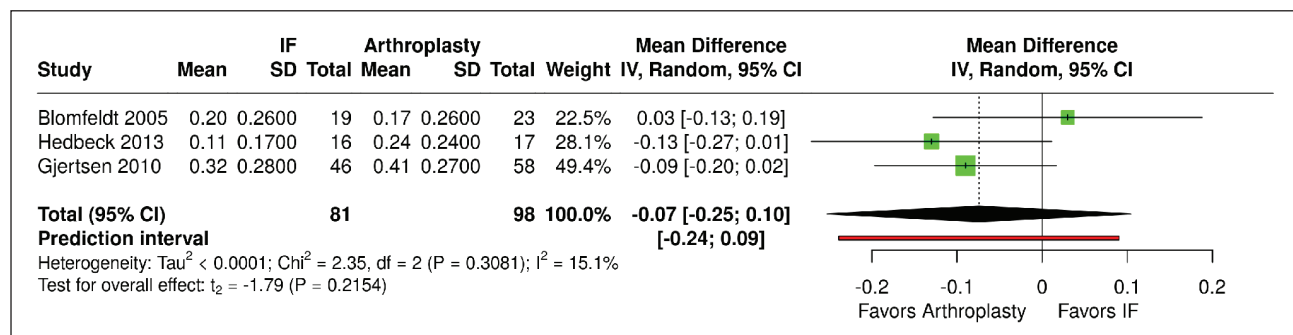


Figure 5. Forest plot of the EQ-5D index at 12 months.

a higher rate of reoperation or revision and with higher mortality at all three follow-up landmarks, while offering a numerically shorter operation. The mortality estimates were homogeneous ($I^2 = 0\%$) and the CIs excluded the

null value of 1 at every landmark; the prediction interval also excluded 1 at one and two years, but not at the short-term landmark, where a future comparable study could still show no difference. The reoperation signal, although

large, rests on only two small randomized trials totaling 119 patients, and its CI spans a modest to a very large effect. The EQ-5D index at 12 months did not differ detectably between strategies. Certainty of evidence was very low for every outcome, so these findings indicate a consistent direction of effect rather than a precise estimate of benefit.

Comparison with previous literature

The reoperation findings agree with evidence from the wider geriatric femoral neck fracture population. A systematic review of nondisplaced fractures reported an approximately 70% lower reoperation risk with HA than with fixation [4], a more recent review favored HA where avoidance of revision was the priority [22], and in a nationwide cohort of 3,909 older adults reoperation was more frequent after IF [23]. The competing risk of death, noted in that cohort, is particularly relevant in dementia: patients may die before a failed fixation is revised, so reoperation rates may understate the true burden of mechanical failure. The mortality signal is likewise consistent with the poor prognosis of hip fracture in dementia. A Swedish national study of more than 111,000 operated patients reported 30-day and 12-month mortality of 13% and 39% in patients with dementia versus 6% and 20% in those without [24], and other population data and a systematic review report similar excess mortality alongside poorer recovery, delirium, and dislocation [25,26].

Clinical interpretation

The excess reoperation after fixation is biomechanically coherent. Fixation preserves the native femoral head but depends on union, maintained reduction, implant stability, and intact femoral head perfusion. Fracture morphology and displacement are established determinants of fixation failure [27], a posterior tilt of 20° or more substantially increases reoperation after osteosynthesis of nondisplaced fractures [28], and a Swedish register study of 5,428 older adults documented a clinically relevant rate of later conversion to arthroplasty [29]. A smaller index operation can therefore be offset later by nonunion, secondary displacement, osteonecrosis, or conversion surgery.

The survival difference warrants more caution. Arthroplasty does not modify the systemic vulnerability of dementia, which is typically accompanied by frailty, multimorbidity, impaired baseline mobility, and reduced physiological reserve [24,30], and part of the difference seen in the contributing observational cohorts is likely to reflect treatment selection. One plausible mechanism is earlier restoration of mechanical stability: arthroplasty bypasses fracture healing and permits immediate mobilization, which has been associated with lower 30-day mortality in a meta-analysis of approximately 300,000 patients, although healthier patients also mobilize earlier [31]. Cognitively impaired patients are less likely to mobilize on the first postoperative day or to receive rehabilitation [32], and pre-existing cognitive impairment predisposes to postoperative delirium, which itself predicts poorer recovery [33]. The choice

of operation is therefore inseparable from the quality of perioperative orthogeriatric care [34].

The shorter operative time with fixation remains relevant for physiologically fragile patients, but the substantial heterogeneity we observed ($I^2 = 78.6\%$) shows that this advantage varies with technique, workflow, and operator experience, and economic modelling suggests the greater initial burden of HA may be offset by avoided reoperations [35]. Implant stability deserves particular attention in dementia because impaired adherence to movement precautions increases instability risk: a Norwegian registry analysis found more reoperations after HA in cognitively impaired patients, driven mainly by dislocation [20], and cohort data report a 90-day dislocation risk of 12% in patients with dementia versus 5% in those without [36]. Dual-mobility constructs may mitigate this [37], but the only dementia-specific trial in our review was far too small to be informative. Finally, the absence of a detectable EQ-5D difference should not be read as equivalent recovery, since self-report is affected by cognition, proxy and patient assessments diverge, and mortality selectively removes the frailest patients before later follow-up; mortality, walking recovery, dependence, and caregiver burden are therefore essential companion outcomes [38].

Limitations

The evidence base was small and clinically heterogeneous: only eight studies were eligible, differing in fracture patterns, procedures, definitions of dementia, and follow-up duration. Two contributing cohorts reported hip fracture rather than femoral neck fracture specifically, and in the Taiwanese claims cohort, the fracture pattern could not be separated, which introduces indirectness into the mortality analyses in particular. Several analyses included few studies, precluding formal assessment of publication bias and subgroup effects. The randomized evidence carried methodological concerns, and the observational studies were at serious or critical risk of bias, mainly from confounding and treatment selection. Dementia severity, frailty, prefracture mobility, residential status, fracture displacement, and rehabilitation exposure were not reported consistently, yet each is closely related to outcome and may account for part of the observed differences [24,32]. The wide CI for reoperation indicates that the magnitude of the arthroplasty advantage remains poorly defined. Only two small trials could be pooled for reoperation and for operative time, because the one registry cohort reporting reoperation did so for its entire hip fracture population; for its cognitive impairment stratum that report provides only baseline characteristics and patient-assessed outcomes, so its reoperation data could not be used without violating our eligibility criterion. The single trial comparing two arthroplasty constructs was likewise too small to inform the choice between them.

Implications for practice and research

For most patients with dementia or cognitive impairment and a displaced femoral neck fracture, these data support arthroplasty as the default strategy, with IF reserved for

selected patients in whom the fracture configuration is favorable or physiological reserve is severely limited. Future trials should enroll patients with defined levels of cognitive impairment, stratify randomization by fracture displacement, prefracture mobility, frailty, and dementia severity, and extend outcomes beyond mortality and revision to walking recovery, delirium, institutionalization, days at home, caregiver burden, and quality of life within standardized orthogeriatric pathways [32]. A dedicated comparison of HA with dual-mobility THA is needed for patients at high risk of instability. Throughout, decisions should rest on baseline mobility, frailty, dementia severity, and goals of care rather than on a cognitive diagnosis alone [2,24].

Conclusion

In patients with dementia or cognitive impairment sustaining a hip fracture, IF was associated with a shorter operation but with substantially more reoperations and higher mortality than arthroplasty, whereas health-related quality of life at 12 months did not differ detectably. Arthroplasty avoids the risk of fracture-healing failure and supports stable early mobilization, but the certainty of the evidence is very low and residual confounding cannot be excluded. Treatment should therefore be individualized according to fracture characteristics, physiological reserve, prefracture function, dementia severity, and instability risk.

List of Abbreviations

CI	Confidence Interval
EQ-5D	EuroQol 5-Dimension
FNF	Femoral neck fracture
GRADE	Grading of recommendations assessment, development and evaluation
HA	Hemiarthroplasty
IF	Internal fixation
MD	Mean difference
PI	Prediction interval
PRISMA	Preferred reporting items for systematic reviews and meta-analyses
PROSPERO	International prospective register of systematic reviews
RCT	Randomized controlled trial
RD	Risk difference
RoB 2	Cochrane risk-of-bias tool for randomized trials
ROBINS-I	Risk Of Bias In Non-randomized Studies of Interventions
RR	Risk ratio
SD	Standard Deviation
THA	Total hip arthroplasty

Conflict of interest

The authors declare that they have no competing interests, financial relationships, or personal affiliations that could have influenced the work reported in this manuscript.

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Consent to participate

This study is a systematic review and meta-analysis of previously published studies using publicly available, de-identified data. No patients were directly recruited, and no identifiable patient information or animal subjects were involved.

Ethics Approval

Not applicable.

Author details

Abdulaziz Abdullah Alqahtani¹, Ahmad Ghaleb Kadhim², Albaraa Mansour Alamoudi³, Nawaf Ahmed Alghamdi⁴, Abdulaziz Alhassan Khamjan⁵, Sultan Fahad Alomari⁶, Razan Afif Alshammari⁷, Mohammed Ahmed Almagali⁸, Mubarak Mohammed Alshahrani⁸, Saeed Salim Alrumaih¹, Ghazi Alqahtani⁹

1. College of Medicine, King Khalid University, Abha, Saudi Arabia
2. College of Medicine, Imam Abdulrahman Bin Faisal University, Dammam, Saudi Arabia
3. College of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia
4. College of Medicine, University of Jeddah, Jeddah, Saudi Arabia
5. College of Medicine, Jazan University, Jazan, Saudi Arabia
6. Ibn Sina National College, Jeddah, Saudi Arabia
7. College of Applied Medical Sciences, Jouf University, Sakaka, Saudi Arabia
8. Batterjee Medical College, Aseer, Saudi Arabia
9. Department of Orthopedic Surgery, King Khalid University Medical City, Abha, Saudi Arabia

Supplementary content (If any) is available online.

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