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META-ANALYSIS

Cemented *versus* uncemented stems for revision total hip replacement: A systematic review and meta-analysis

Hany Elbardesy, Fitzgerald Anazor, Mohammad Mirza, Mohamed Aly, Annis Maatough

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Abstract

BACKGROUND

The popularity of uncemented stems in revision total hip arthroplasty (THA) has increased in the last decade.

AIM

To assess the outcomes of both cemented and uncemented stems after mid-term follow up.

METHODS

This study was performed following both the Preferred Reporting Items for Systematic Reviews and Meta-analyses Statement and the Cochrane Handbook for systematic reviews and meta-analysis guidelines. Articles were chosen irrespective of country of origin or language utilized for the article full texts. This paper included studies that reviewed revision THA for both cemented or uncemented long stems.

RESULTS

Three eligible studies were included in the meta-analysis. Analysis was conducted by using Review Manager version 5.3. We computed the risk ratio as a measure of the treatment effect, taking into account heterogeneity. We used random-effect models. There were no significant differences found for intraoperative periprosthetic fractures [risk ratio (RR) = 1.25; 95% confidence interval (CI): 0.29-5.32; *P* =

0.76], aseptic loosening (RR = 2.15, 95%CI: 0.81-5.70; P = 0.13), dislocation rate (RR = 0.50; 95%CI: 0.10-2.47; P = 0.39), or infection rate (RR = 0.99, 95%CI: 0.82-1.19; P = 0.89), between the uncemented and the cemented long stems for revision THA after mid-term follow-up.

CONCLUSION

This study has evaluated the mid-term outcomes of both cemented and uncemented stems at first-time revision THA. In summary, there were no significant differences in the dislocation rate, aseptic loosening, intraoperative periprosthetic fracture and infection rate between the two cohorts.

Key Words: Long stem; Cemented; Uncemented; Revision total hip arthroplasty; Meta-analysis

Core Tip: This paper included a meta-analysis of three studies involving 7600 revision total hip replacements, of which 3050 were performed using cemented stems, while 2539 were performed utilising uncemented stems. Based on the evidence from this study, there are no statistically significant differences in the rates for intraoperative periprosthetic fractures, aseptic loosening, dislocation and periprosthetic joint infection, for the cemented and uncemented long stems in revision total hip arthroplasty. Nevertheless, there was significant heterogeneity in the included studies for periprosthetic fractures, aseptic loosening and dislocation.

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INTRODUCTION

The numbers of revision total hip replacement (rTHR) have been increasing due to increasing numbers of primary hip replacements worldwide[1]. The uncemented femoral stem has shown increasing popularity among revision hip surgeons[2,3]. However, some authors claim that the cemented long stem prothesis has a longer life span than the uncemented stem, especially in the elderly patient cohort[4,5]. Older studies did not find any difference in the survival rate between the two stem types[6]. 71% of Danish orthopaedic surgeons prefer the uncemented stem. However, only 24% in Sweden use this type of femoral stem[7]. For the first decade of this century, there has been a dramatic increase in the number of uncemented primary hip replacements[8]. Evolutions in the design of the uncemented long femoral stem has added more stability to the distal femur, with a marginal effect on the bone loosening process, which is less predictable, especially in revision surgeries[9]. Consequently, the uncemented stem is a good choice in scenarios where there is bone loss[10]. This study aims to use meta-analysis and systematic review techniques to assess the outcomes of both the uncemented and cemented femoral stems in rTHR. The primary outcome measures were periprosthetic fractures and aseptic loosening. The secondary outcome measures were the dislocation and infection rates.

MATERIALS AND METHODS

Literature search

This study was conducted following both the Preferred Reporting Items for Systematic Reviews and Meta-analyses Statement as shown in Figure 1, and the Cochrane Handbook for systematic reviews and meta-analysis[11]. An initial search was conducted using PubMed, Google scholar and the Cochrane Library. Grey and unpublished literature were also explored by searching: Grey Matters BIOSIS Previews, International Clinical Trial Registry, ClinicalTrials.gov, UK Clinical Trials Gateway, Networked Digital Library of Theses and Dissertations, UK Clinical Research Network Study Portfolio, Open Grey and Grey Literature Report. The following keywords were used alone or in combinations: Cemented, uncemented, long stem, revision, and total hip arthroplasty (THA). Articles published up to December 2022 were included in the literature search, and were limited to studies in human subjects published in any language. Additionally, we cross-referenced the bibliographies of retrieved articles and review papers to ensure that we captured all relevant studies.

Eligibility criteria

All full-text observational studies that evaluated the outcomes of both cemented and uncemented stems in rTHR were included. All biomechanical, radiological, and cadaveric studies were excluded. Furthermore, any study that did not meet one or more of the eligibility criteria were excluded.

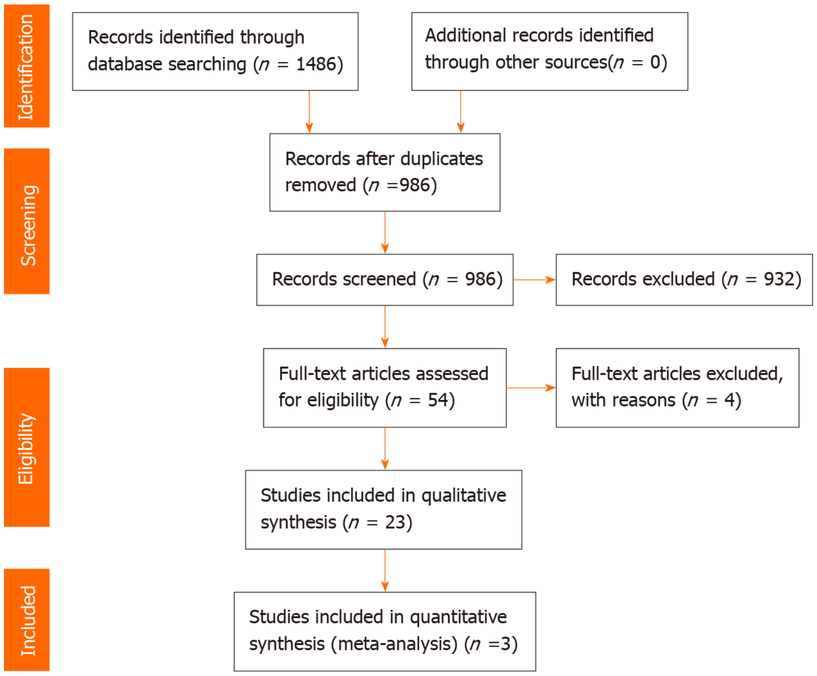

Figure 1 Preferred reporting items for systematic reviews and meta-analyses flow chart.

Study selection and data extraction

Three authors (Elbardesy H, Anazor F, and Maatough A) independently screened all titles and abstracts identified from the initial search to assess their eligibility for inclusion. Identified titles and abstracts from the initial search were then screened and the full text articles of the eligible manuscripts were obtained. After all eligible full text manuscripts had been evaluated for inclusion criteria eligibility, data extraction was conducted by the same reviewers. Any discrepancies with collected data were resolved by consensus between the reviewers. Outcome measures (periprosthetic fracture, aseptic loosening, dislocation rate, and infection) were recorded. Additionally, the study titles, year of publication, the publishing journal, type of study, level of evidence, number and the brand of the stems, period of follow up, gender and age of the patients included in each study were analysed.

Risk of bias

The risk of bias for retrospective non-randomized studies was assessed using the Newcastle-Ottawa Scale[12], as shown in Table 1. Four reviewers (Elbardesy H, Anazor F, Mirza M, and Maatough A) independently crossed-checked the quality of the included studies. Disagreements were resolved through consensus discussions.

Statistical analysis

Statistical analysis was performed using Review Manager, version 5.3 (The Nordic Cochrane Centre, The Cochrane Collaboration, 2009, Copenhagen, Denmark)[13]. Heterogeneity between studies was evaluated using the I^2 statistic and a χ^2 of < 0.05 was used to determine the significance of the heterogeneity between studies[11]. Risk ratios (RRs) were reported for dichotomous variables such as wound complications, whereas mean differences and standard deviations (SDs) were used for continuous variables. All analyses were conducted using the Mantel-Haenszel random-effects model. The results of our meta-analysis were then illustrated using forest plots, which used a 95% confidence interval (CI) for each study. A *P* value of < 0.05 was taken to be of statistical significance. Variables that were inconsistently reported were investigated in the systematic review portion of this study[11].

RESULTS

Study characteristics

Our literature search revealed 1486 unique references. After reviewing the titles and abstracts of all studies, three studies were eligible for both quantitative and qualitative analysis. The three selected studies included 7600 revision THRs, of which 3050 were performed using cemented stems, while 2539 were performed utilising uncemented stems. 23 studies were included in the qualitive analysis: Six of them investigated the cemented stems, while 17 focused on uncemented stems (Figure 1). A summary of study characteristics and patients' demographics is presented in Tables 2-6.

Table 1 Newcastle-Ottawa Scale for assessing the quality of observational studies

	Selection				Comparability	Exposure			Total
Ref.	Representativeness of the exposed cohort	Selection of the non-exposed cohort	Ascertainment of exposure	Demonstration that outcome of interest was not present at start of study	Comparability of cohorts on the basis of the design or analysis	Assessment of outcome	Was follow-up long enough for outcomes to occur	Adequacy of follow up of cohorts	Total number of stars
Tyson *et al* [39], 2021	*	*	*	*	**	*	*	*	9
Weiss *et al* [38], 2011	*	*	*	*	*	*	*	*	8
Iorio *et al* [6], 2008	*	*	-	*	*	*	*	*	7

Table 2 Study characteristics

Ref.	Country	Journal	Study type	Centres	Level of evidence	Number of stems	Stem brand for cemented	Stem brand for uncemented
Tyson *et al* [39], 2021	Sweden	*Acta Orthopaedica*	Observational study	Multi	III	266 cemented, 601 uncemented	Lubinus SPII 123 (46%), exeter 94 (35%), spectron 49 (18%)	MP 291 (48%), restoration 162 (27%), wagner 78 (13%), revitan 70 (12%)
Weiss *et al*[38], 2011	Sweden	*Acta Orthopaedica*	Observational study	Multi	III	1073 cemented, 812 uncemented	Lubinus SPII 610 (57%), exeter long stem 248 (23%), spectron revision hip system 215 (20%)	MP stem 812 (100%)
Iorio *et al*[6], 2008	United States	*Journal of arthroplasty*	Prospective cohort study	Single	II	43 cemented, 43 uncemented	13 premise, 6 precision, 5 reliance (stryker), 3 re cemented, 2 charnley elite plus, 2 ultima, 1 PFC (depuy), 4 calcar replacing, 7 extra long	S-ROM modular metaphyseal femoral stem 31 (72%), calcar replacing 9 (23%), extra long 3 (7.7%)

Study characteristic for the studies included in the MA.

Table 3 Patient's demographics

Ref.	Gender M	Age (SD)	Follow up in years (SD)
Tyson *et al*[39], 2021	Uncemented 318 (53%), cemented 138 (52%)	Uncemented 72 (10), cemented 74 (9)	Uncemented 4 (3), cemented 5 (3)
Weiss *et al*[38], 2011	Uncemented 443 (55%), cemented 544 (51%)	Uncemented 72 (11), cemented 76 (9)	Uncemented 3.4 (2.9), cemented 4.2 (2.5)
Iorio *et al*[6], 2008	22 cemented (51%), 22 uncemented (51%)	Uncemented 71.2 (9), cemented 67.5 (10)	Uncemented 7 (1), cemented 9 (1.5)

SD: Standard deviation.

Patient baseline characteristics

For the meta-analysis, the subjects in the uncemented group had an average age of 71 years and 1159 (45.6%) males, with an average follow-up period of 4.8 (± 2.3) years. The cemented cohort had a similar distribution, with an average age of 71.6 years and 1391 (45.6%) males, with an average follow-up period of 6 (± 2.33) years.

Table 4 Study characteristics for the studies about the uncemented stem

Ref.	Total number	Country	Journal	Study type	Centres	Level of evidence
Mahoney *et al*[20], 2010	40	United States	*JOA*	ORS	Single	3
Hasegawa *et al*[22], 2021	45	Japan	*International Orthopaedics*	ORS	Single	3
Zheng *et al*[23], 2021	34	China	*OSJ*	ORS	Single	3
Wallace *et al*[24], 2020	55	United Kingdom	*J Arthroplasty*	ORS	Single	3
Zang *et al*[25], 2019	40	China/Japan	*JOS (Hong Kong)*	ORS	Single	3
Herry *et al*[26], 2019	116	Multi	*International Orthopaedics*	ORS	Multi	3
Shen *et al*[27], 2014	34	China	*COAJ*	ORS	Single	3
Wang *et al*[28], 2020	73	China	*Hip International*	ORS	Single	3
Singh *et al*[34], 2013	53	India	*IJO*	ORS	Single	3
Tsukeoka *et al*[41], 2011	14	Japan	*Modern Rheumatology*	ORS	Single	3
Oetgen *et al*[29], 2008	28	United States	*JOT*	ORS	Single	3
Sotereanos *et al*[36], 2006	16	United States	*JBJS*	ORS	Single	3
Philippot *et al*[35], 2009	43	France	*OTSR*	ORS	Single	3
Thorey *et al*[30], 2008	79	Germany	*AOTS*	ORS	Single	3
Malkani *et al*[31], 1996	74	United States	*JOA*	ORS	Single	3
Mulliken *et al*[32], 1996	66	Canada	*CORR*	ORS	Single	3
Meding *et al*[33], 1994	24	United States	*JOA*	ORS	Single	3

ORS: Observational retrospective study; *JOA*: The Journal of Arthroplasty; *OSJ*: *Orthopaedic Surgery Journal*; *CORR*: *Clinical Orthopaedics and Related Research*; *AOTS*: *Archives of Orthopaedic and Trauma Surgery*; *OTSR*: *Orthopaedics & Traumatology, Surgery & Research*; *JBJS*: *Journal of Bone & Joint Surgery*; *JOT*: *Journal of Orthopaedics & Traumatology*; *IJO*: *Indian Journal of Orthopaedics*; *OSJ*: *Orthopaedic Surgery Journal*; *CJRRS*: *Chinese Journal of Reparative & Reconstructive Surgery*; *JOS*: *Journal of Orthopaedic Surgery (Hong Kong)*; *COAJ*: *Chinese Orthopaedic Association Journal*.

Systematic review

Intraoperative periprosthetic fracture: Six studies reported periprosthetic fractures with the use of cemented stems. Intraoperative periprosthetic fractures were reported in 59 cases (10.64 %) out of a total of 554 hips[14-19]. In the uncemented stem group, 16 studies reported intraoperative periprosthetic fractures in 112 cases out of 824 (13.59 %)[20-35]. The percentage of the periprosthetic fractures was lower in the cemented stem cohort (Tables 7 and 8).

Aseptic loosening: Five studies (with a total number of 375 revision THRs) reported 22 cases of aseptic loosening with cemented stems (5.87%)[14-18]. However, 13 studies with a total of 706 revision THRs, reported 34 cases of aseptic loosening (4.82%)[20,22,26-33].

Dislocation rate: 15 studies which included 689 uncemented stems[20,21-29,31,33-36] reported 29 (4.21 %) cases of dislocation. Conversely, for cemented stems, five studies (with a total of 375 hips) reported a dislocation rate of 4.53 %.

Infection: 14 studies with 626 hips using uncemented long stems reported a total of 28 cases (4.47 %) of post operative infection[20,22-27,30,31,33,35-37]. On the other hand, five studies with a total of 484 cemented hip stems, reported a postoperative infection rate of 4.33%[14,15,17-19].

Meta-analysis

The meta-analysis comparatively assessed the outcomes of both cemented and uncemented stems in rTHR, and the outcomes of both stem types as it correlates to four postoperative outcomes: Intraoperative periprosthetic fracture, aseptic loosening, dislocation rate and infection (after a mid-term follow up period 4.8-6 years). As mentioned earlier, only three studies were eligible for inclusion in the meta-analysis.

Periprosthetic fractures: The three included eligible studies reported on periprosthetic fractures, encompassing a total of

Table 5 Patients demographic for the study involved uncemented stem

Ref.	Gender male/female	Age in years (SD)	Follow up in years (SD)
Mahoney *et al*[20], 2010	18/22	64 (30.5)	10.2 (2.8)
Zhao *et al*[21], 2009	12/8	65 (9.5)	3 (1.1)
Hasegawa *et al*[22], 2021	12/33	62.6 (26)	13.8 (2.2)
Zheng *et al*[23], 2021	16/18	63.9 (11.7)	9.1 (2.5)
Wallace *et al*[24], 2020	19/36	66.4 (9.3)	13.2 (2.17)
Zang *et al*[25], 2019	15/25	62 (19.5)	15.7 (7.1)
Herry *et al*[26], 2019	55/61	68 (12)	10 (3)
Shen *et al*[27], 2014	21/13	65 (13.5)	6 (1.5)
Wang *et al*[28], 2020	33/42	62.6 (16.5)	12.6 (2)
Singh *et al*[34], 2013	42/6	54.7 (15.3)	14 (4.5)
Oetgen *et al*[29], 2008	18/10	59 (12)	5.5 (1.5)
Sotereanos *et al*[36], 2006	9/7	66 (17.5)	7.4 (6.5)
Philippot *et al*[35], 2009	10/33	54 (17.5)	5.3 (1.5)
Thorey *et al*[30], 2008	33/46	72.4 (28.5)	4 (2)
Malkani *et al*[31], 1996	40/ 34	67.1 (10.1)	6.8 (3.9)
Mulliken *et al*[32], 1996	31/32	62 (12)	3 (1)
Meding *et al*[33], 1994	17/7	63.8 (29)	3.6 (2)

SD: Standard deviation.

Table 6 Study characteristics of the cemented stem

Ref.	Country	Journal	Study type	Canters	Level of evidence	Total number	Gender male/female	Age	Follow up in years (SD)
Te Stroet *et al*[14], 2014	Netherlands	*BJJ*	ROS	Single centre	3	37	17/20	76 (39-93)	9 (4)
Randhawa *et al* [15], 2009	United Kingdom	*JOT*	ROS	Single centre	3	57	27/30	73 (37-94)	3.25 (3)
Stigbrand and Ullmark, 2017	Sweden	*JOA*	ROS	Single centre	3	69	40/29	69	7 (3.2)
Pallaver *et al*[19], 2018	Switzerland	*AOTS*	ROS	Single	3	178	126/52	68.4 (36-90)	9.3 (5.2)
Davis *et al*[17], 2003	United States	*JBJS*	ROS	Single	3	48	27/21	67 (47-82)	6.5 (2)
Turner *et al*[18], 1987	United States	*JOA*	ROS	Single	3	165	81/84	62.1 (22-92)	6.7 (1.5)

ROS: Retrospective observational study; *BJJ*: *The Bone & Joint Journal*; *MSM*: *Medical Science Monitor*; *JOT*: *Journal of Orthopaedics & Traumatology*; *JOA*: *Journal of Arthroplasty*; *AOTS*: *Archives of Orthopaedic and Trauma Surgery*; *JBJS*: *The Journal of Bone and Joint Surgery*.

2838 hips. 252 periprosthetic fractures were reported out of the 1382 hips in the cemented long stem cohort, and 84 events were reported in the 1456 hips receiving uncemented stems. Heterogeneity analysis demonstrated high statistical evidence for variation within the studies (I^2 = 94%). Data pooled by random-effects model suggested insignificant difference in periprosthetic fractures among the two cohorts (RR = 1.25, 95%CI: 0.29-5.32; P = 0.76; Figure 2A).

Aseptic loosening: All three studies reported on aseptic loosening after rTHR from a total of 2838 revision hips. Heterogeneity analysis demonstrated high statistical evidence for variation within the studies (I^2 = 96%). Although aseptic loosening rates were less among patients with uncemented stems (RR = 2.15, 95%CI: 0.81-5.70), statistical analysis showed no significant differences (P = 0.13; Figure 2B).

Table 7 Outcomes of the uncemented stem

Ref.	Intraoperative periprosthetic fracture (%)	Aseptic loosening (%)	Dislocation (%)	Infection (%)
Mahoney *et al*[20], 2010	1 (2.5)	1 (2.5)	13 (32.5)	1 (2.5)
Hasegawa *et al*[22], 2021	1 (2.2)	1 (2.2)	1 (2.2)	0 (0)
Zheng *et al*[23], 2021	7 (20.5)	3 (8.8)	1 (2.9)	3 (8.8)
Wallace *et al*[24], 2020	2 (3.6)	0 (0)	3 (5.4)	2 (3.6)
Zang *et al*[25], 2019	11 (27.5)	1 (2.5)	2 (5.0)	2 (5.0)
Herry *et al*[26], 2019	12 (10.3)	4 (3.4)	2 (1.7)	3 (2.5)
Shen *et al*[27], 2014	0 (0)	0 (0)	0 (0)	0 (0)
Tsukeoka *et al*[41], 2011	9 (64.2)	NA	1 (7.1)	NA
Wang *et al*[28], 2020	0 (0)	5 (6.8)	0 (0)	2 (2.7)
Singh *et al*[34], 2013	0 (0)	NA	3 (5.6)	7 (13.2)
Oetgen *et al*[29], 2008	3 (10.7)	0 (0)	0 (0)	NA
Sotereanos *et al*[36], 2006	NA	NA	0 (0)	0 (0)
Philippot *et al*[35], 2009	2 (4.6)	NA	1 (2.3)	3 (6.9)
Thorey *et al*[30], 2008	16 (20.2)	2 (2.5)	NA	2 (2.5)
Malkani *et al*[31], 1996	34 (45.9)	5 (6.75)	2 (2.7)	1 (1.3)
Mulliken *et al*[32], 1996	20 (30.3)	12(18.1)	NA	NA
Meding *et al*[33], 1994	4 (16.6)	0 (0)	3 (12.5)	1 (4.1)

NA: Not applicable.

Table 8 Outcomes of the cemented stem

Ref.	Periprosthetic fracture	Aseptic loosening	Dislocation	Infection
Te Stroet *et al*[14], 2014	9 (24.3)	0 (0)	3 (8.1)	4 (10.8)
Randhawa *et al*[15], 2009	4 (7.0)	1 (1.7)	1 (1.7)	7 (12.2)
Stigbrand and Ullmark, 2017	3 (4.3)	4 (5.7)	2 (2.8)	NA
Pallaver *et al*[19], 2018	2 (1.1)	3 (1.7)	NA	6 (3.3)
Davis *et al*[17], 2003	7 (14.5)	10 (20.8)	7 (14.5)	1 (2.0)
Turner *et al*[18], 1987	34 (20.6)	7 (4.2)	4 (2.4)	3 (1.8)

NA: Not applicable.

Dislocation rate: Of the 1382 cemented stems within the three studies, 146 (10.56 %) dislocations were reported, whereas 568 (39.01%) events were noted in the 1456 rTHAs performed with uncemented stems. Heterogeneity analysis demonstrated high statistical evidence for heterogeneity (I^2 = 98%). Although dislocation rates among patients with cemented stems was more than that seen in the uncemented group, the results were statistically insignificant (RR = 0.50; 95%CI: 0.10-2.47; P = 0.39; Figure 2C).

Infection rate: The three studies reported on infection rate with all of them reporting almost similar infection rates. Heterogeneity analysis demonstrated low statistical evidence for variation within the study (I^2 = 0%). There was no statistically significant difference between the groups (RR = 0.99, 95%CI: 0.82-1.19; P = 0.89; Figure 2D).

DISCUSSION

The most important finding in this review was the lack of statistically significant differences in the assessed outcomes after mid-term follow-up periods (4.8-6 years), between cemented and uncemented stems after first time revision THA.

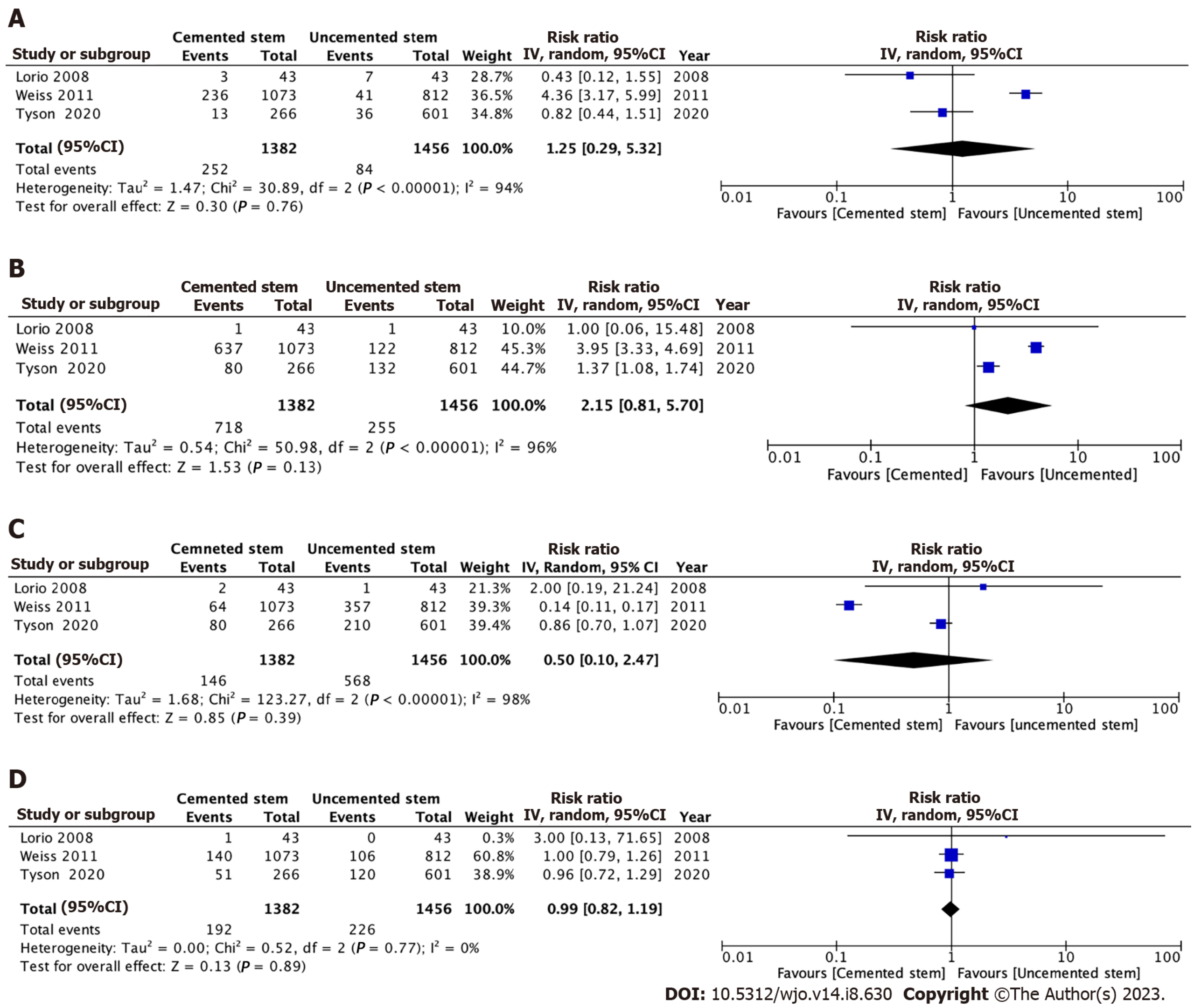

Figure 2 Forest plot of comparison. A: 1ry outcome, outcome: Periprosthetic fracture; B: 1ry outcome, outcome: Aseptic loosening; C: 2ry outcome, outcome: Dislocation rate; D: 2ry outcome, outcome: 1.4 infection rate. CI: Confidence interval.

To our knowledge, no other meta-analysis or systematic review has compared outcomes between cemented and uncemented stems for first-time revision THRs.

The preference of the femoral stem in revision THA is mainly dependent on the surgeon's choice. However, the uncemented stem is becoming more popular due to the anchoring effect of the distal part of the femoral stem within intact bone. Moreover, the uncemented stem offers different options in the proximal body of the prosthesis to achieve proper soft tissue tension, femoral anteversion, and femoral offset[9]. Some authors claim that the use of the uncemented stem may increase the risk of early postoperative failure but confers less risk of aseptic loosening in the long-term[4,38]. Another study reported better short-term (three years) outcomes for the cemented stem than the uncemented stem[39]. Tyson *et al*[39] reported the findings from a study of 867 uncemented and cemented revision THAs. Their study provided a hazard ratio (HR) of 5 for uncemented *versus* cemented stems for dislocations needing re-revision within the first three years. The HR gradually decreases to 3 between years 4-8. They postulated that the increased risk of subsidence in the uncemented revisions might lead to an increased risk of dislocation[39]. Similarly, Weiss *et al*[9] reported data collected from the Swedish THA register from 1999 to 2007. With a retrospective case-control study design, they showed an increased risk of re-revision in the uncemented hip prostheses in the first three years postoperatively. They included only one design (MP-Waldmar Link) of uncemented, titanium alloy, extensively-coated femoral stem owing to its popularity in Sweden. The control group had a variety of cemented stems implanted. There were 812 and 1073 cases of uncemented and cemented stems, respectively. Over a period of three years, the modular uncemented (MP) stem showed greater risk of re-revision than the cemented group. Crude risk of reoperation in the MP stem group was 5%. The commonest reason for re-revision was dislocation. The difference in re-revision rate was only found in the first 3 years postoperatively. Subsequently, after the three-year period, there was no significant difference in revision rates[38].

Davis *et al*[17] reported 14 (29%) cases of aseptic loosening in a series of 48 hips over a mean follow up period of 6.8 years. 10 (20.8%) of these were revised. The authors suggest that reduced stock of cancellous bone (arising from bone loss which occurs during loosening of the primary stem and during femoral preparation for prosthesis insertion) allows for less interdigitation of cement, which leads to an earlier onset of aseptic loosening. Whilst plausible, when comparing outcomes of primary against revision cemented stems, this does not explain why their figures are lower compared to other series reporting on cemented stems. Earlier generation cementing techniques may explain this[17]. Other authors report aseptic loosening rates as high as 18.1%[32]. There appears to be no inferable pattern that may explain this from data provided. Systematic data aggregating levels of bone defects with rates of aseptic loosening may help shed light on the relationship between bone loss and aseptic loosening.

Te Stroet *et al*[14] reported nine (24%) intraoperative periprosthetic fractures but reported that none occurred during graft impaction[14]. They suggested that consistently worse preoperative bony defects than that seen in comparative studies was the causative factor. Most fractures occurred during stem extraction. They proposed that the use of a Wagner osteotomy may help reduce the risk of such complications[14]. Sierra *et al*[40] do not report on intraoperative fractures but discuss one case of femoral perforation which subsequently led to the development of a post-operative fracture. Impaction bone grafting allows for initial stability[16], but risks inducing fractures[40]. Sierra *et al*[40] suggested that the generous release of a circumferential rim of proximal soft tissues led to reduced bending and torsional forces during stem preparation, thereby reducing the risk of fractures. Relatively higher numbers of periprosthetic fractures were reported with uncemented stems. Tsukeoka *et al*[41] in their series of 20 hips, reported nine fractures (45%) and one perforation. Malkani *et al*[31] reported a similar 45.1% intraoperative fracture rate. Both studies reported on the findings from the use of proximally coated stems that are reliant on the "fit-and-fill" philosophy. Malkani *et al*[31] suggested that the impaired quality of bony, along with the size and stiffness of the implant, might explain the observed numbers of periprosthetic fractures. In conclusion, both types of femoral stems are safe options for revision THA.

Study limitations

One of the limitations of this study, was the fact that there were only three studies included in the meta-analysis. Significant heterogeneity occurred between the studies for the four assessed outcomes except for infection rate. Furthermore, all included studies were retrospective. These types of observational studies are more prone to bias in data collection, and are affected by the inability to control for all the variables assessed between the different cohorts included in each study. Another limitation was the fact that the postoperative follow up period was not long enough. Randomized control studies with long-term follow up periods comparing outcomes between these types of femoral stem are required, in order to provide data of a higher quality in this area.

CONCLUSION

In summary, this study has evaluated the mid-term outcomes of both cemented and uncemented stems for first time revision THA. No statistically significant differences in dislocation rate, aseptic loosening, intraoperative periprosthetic fracture and infection rate between the two cohorts were found. Nevertheless, the evidence from this study should be interpreted with caution, due to the unavailability of any randomized controlled studies for the meta-analysis. Finally, significant heterogeneity occurred between the studies for the four assessed outcomes, except for infection rate.

ARTICLE HIGHLIGHTS

Research background

There is no published systematic review and meta-analysis looking at the research question in this study, despite the large number of revision total hip arthroplasties (THA) performed worldwide.

Research motivation

We have had this nagging question: "Is there any scientific evidence from published studies that shows a difference in outcomes between the cemented and uncemented stems, for revision total hip arthroplasty?"

Research objectives

To assess the outcomes (intraoperative periprosthetic fractures, aseptic loosening, dislocation and infection rates) of both cemented and uncemented stems after mid-term follow up.

Research methods

A meta-analysis of non-randomized interventional studies.

Research results

This paper included a meta-analysis of three studies involving 7600 revision total hip replacements, of which 3050 were performed using cemented stems, while 2539 were performed utilising uncemented stems. There were no statistically significant differences found for intraoperative periprosthetic fractures [risk ratios (RRs) = 1.25; 95% confidence interval (CI): 0.29-5.32; *P* = 0.76], aseptic loosening (RR = 2.15, 95%CI: 0.81-5.70; *P* = 0.13), dislocation rate (RR = 0.50; 95%CI: 0.10-2.47; *P* = 0.39), or infection rate (RR = 0.99, 95%CI: 0.82-1.19; *P* = 0.89), between the uncemented and the cemented long stems for revision THA after mid-term follow-up.

Research conclusions

Low-moderate quality evidence showing no statistically significant differences between the cemented and uncemented stems for revision THA.

Research perspectives

We believe the evidence from this study should be interpreted with caution, due to the lack of any randomized controlled study being eligible for inclusion in the meta-analysis. Furthermore, significant heterogeneity was found between the included studies.

FOOTNOTES

Author contributions: Elbardesy H and Anazor F involved in the conceptualization of the study and data interpretation; Elbardesy H, Anazor F, and Mirza M contributed to the data analysis; Elbardesy H, Anazor F, and Aly M contributed to the study design; Elbardesy H, Anazor F, and Maatough A involved in the selection and screening of studies; Elbardesy H, Anazor F, Mirza M, Aly M, and Maatough A contributed to the manuscript preparation-writing and editing; and all authors read and approved the final draft of the manuscript.

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