Press-fit cementless acetabular fixation with and without screws

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Abstract

Purpose Cementless acetabular fixation for total hip arthroplasty (THA) is widely used. The question of using screws for a better primary and secondary acetabular fixation has been discussed in the literature in recent years. The aim of this meta-analysis was to compare fixation of acetabular cups with and without screws in total hip arthroplasty.

Methods Electronic databases Embase, PubMed and Cochrane Library were used to search for randomised controlled trials reported through May 2013 of cementless acetabular fixation for THA with and without screws. Two independent reviewers assessed the trials for eligibility and quality. All related data matching our standards were abstracted for meta-analysis by RevMan 5.0. Evaluation criteria included revisions, migration and osteolysis.

Results A total of 1,130 THAs enrolled into five trials were included in this meta-analysis. All studies compared fixation of acetabular cups with and without screws, and our pooled data showed no statistical significance between the two surgical methods in revision, migration and osteolysis.

Conclusion There is no significant difference between cementless acetabular fixation for THA with and without screws in revisions, migration or osteolysis.

Keywords Press fit acetabular fixation · With screws · Without screws · No difference

Introduction

Total hip arthroplasty (THA) is established as a valid treatment option for severe osteonecrosis of the femoral head,

arthritis of the hip and femoral neck fracture. Loss of implant fixation continues to be the most frequent and significant complication of total joint arthroplasty. Whereas recent clinical follow-up series demonstrate excellent long-term fixation of cemented femoral components, the acetabular components of cemented THAs have very high loosening rates [1, 2]. Considerable attention has therefore been directed towards the development of cementless fixation to improve longevity of acetabular reconstructions [3, 4]. In the past two decades, there has been a tendency towards using cementless rather than cemented acetabular cups [5]. Solid primary fixation is essential for bone ingrowth and achieving secondary stability [6–8]. Most authors agree that screws are warranted when there is insufficient primary fixation, especially in osteoporotic bone [9, 10]. Primary fixation of the cup is usually achieved by press-fit fixation that can be enhanced using screws. Locking the screws into their respective cups seems to improve primary fixation. To the best of our knowledge, literature regarding the additive value of locking screws into cups is scarce. The purpose of this study was to examine primary fixation of acetabular cups with or without screws by reoperation, migration and osteolysis.

Methods

Search strategy

All studies on THA performed with cementless acetabular fixation and screws were identified by conducting an intensive search of the literature in major databases (Embase, PubMed and Cochrane Library). We identified all trials published to and including May 2013 that compare cementless acetabular fixation with and without screws in THA. Reference lists and relevant articles referenced in these primary studies were downloaded. The related article function was also used to widen the search

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Fig. 1 Study selection process

results, and we searched the published articles without language limitation.

Study selection

We selected all randomised, controlled trials (RCTs) comparing cementless acetabular fixation with and without screws for THA. These trials reported at least one of the following outcomes: reoperations, migration (or loosening) and osteolysis.

Validity assessment and data abstraction

Two authors independently identified and evaluated the studies. Any disagreements were resolved by a third, independent, author. The quality of each relevant study was assessed using the *Cochrane Handbook for Systematic Reviews of Interventions*, version 5.0.1 [11]. Data was independently extracted by two authors, and differences were discussed with a third, independent, author. Data included outcomes and general characteristics of each study. For all eligible articles, the following data were extracted from original publications: study design, year of publication, participants, with or without screws, reoperations, migration (or loosening) and osteolysis. If data were not directly reported, we calculated or obtained that data indirectly from the original study.

Statistical methods

Statistical analysis for dichotomised outcomes was performed using risk difference (RD) and 95 % confidence intervals (CI). The Mantel–Haenszel method was used to combine RDs for outcomes. We calculated the dichotomised outcomes using the available p value, and a $p < 0.05$ was considered statistically significant. The fixed-effect model was initially applied to all comparisons. The I² index was applied to estimate heterogeneity between trials. If statistical heterogeneity was noted, a random-effects model was used. Sensitivity analysis was performed using a random-effects model to replace a fix-effects model or a fix-effects model to replace a random-effects model. Publication bias has long been recognised as a problem. In this review, we used a funnel plot to investigate publication bias and examined this for signs of asymmetry. All statistical analyses were conducted using Review Manager Version 5.0.

Results

Study identification

We initially identified 299 publications by searching Cochrane Library, PubMed, and Embase. After a preliminary review, 281 studies were excluded for the following reasons: overlapping records or obvious irrelevant studies (Fig. 1). Using full-text analysis, only five studies met inclusion criteria, 13 excluded studies did not concern cementless acetabular fixation in THA (Fig. 1). Therefore, five RCTs comparing cementless acetabular fixation with and without screws were included. These studies, published between 2000 and 2012, ranged in sample size from 37 to 775 THAs and comprised 1,130 THAs (Fig. 1).

Study characteristics and quality

Characteristics of the five included studies are listed in Table 1 [12–16]. The quality of each relevant study, assessed using the

Table 1 Study characteristics

Trials	Sample size (with screws/without screws)	Follow-up	Type of publication	Parameters compared
Iorio et al. 2010 [12]	509/266	2 years	Cohort study	Reoperation, migration, osteolysis
Pakvis et al. 2012 [13]	18/19	2 years	Randomised controlled trial	Reoperation, migration
Röhrli et al. 2004 [14]	22/21	5 years	Randomised controlled trial	Osteolysis
Roth et al. 2006 [15]	110/101	5 years	Case–control study	Migration
Thanner et al. 2000 [16]	30/34	2 years	Randomised controlled trial	Reoperation, migration, osteolysis

Table 2 Quality of each relevant study

Trials	Randomisation	Allocation concealment	Blinding	Lost to follow-up evaluation
Iorio et al. 2010 [12]	No	No	No	No
Pakvis et al. 2012 [13]	Yes	Yes	Yes	Yes
Röhl et al. 2004 [14]	Unclear	Unclear	Unclear	Yes
Roth et al. 2006 [15]	No	No	No	Yes
Thanner et al. 2000 [16]	Yes	Unclear	Unclear	Yes

Fig. 2 Comparison: with versus without screws. Outcome: reoperations

Cochrane Handbook for Systematic Reviews of Interventions, version 5.0.1, is described in Table 2.

Outcomes

Analysis of reoperations and osteolysis were taken using the fixed-effects model. Due to the presence of heterogeneity, we used the random-effects model for migration analysis. There were no significant differences between outcomes. Reoperation RD was -0.02 (95 % CI -0.04 to -0.01 ; $p=0.17$, not statistically significant) (Fig. 2). Migration RD was -0.00 (95 % CI -0.02 to 0.02 ; $p=0.78$, not statistically significant) (Fig. 3). Analytic

outcome of osteolysis indicated that screws did not increase the osteolytic rate. Osteolysis RD was 0.01 (95 % CI -0.01 to 0.03 ; $p=0.51$) (Fig. 4).

Sensitivity analysis

We made a sensitivity analysis by changing the effects model for outcome analysis. Result showed difference after the sensitivity analysis by changing the effects model. Reoperation RD was -0.02 (95 % CI -0.04 to -0.01 ; $p=0.21$, not statistically significant by random-effects model). Migration RD was -0.01 (95 % CI -0.02 to 0.00 ; $p=0.22$), not statistically significant by fixed-

Fig. 3 Comparison: with versus without screws. Outcome: migration

Fig. 4 Comparison: with versus without screws. Outcome: osteolysis

Fig. 5 Comparison: with versus without screws. Outcome: reoperations

Fig. 6 Comparison: with versus without screws. Outcome: migration

Fig. 7 Comparison: with versus without screws. Outcome: osteolysis

effects model). Osteolysis RD was 0.01 (95 % CI -0.01 to 0.02; $p=0.30$).

Publication bias

Publication bias among the studies was determined using funnel plots. Three funnel plots of main outcomes are shown in Figs. 5–7. The more studies exceeding the 95 % CI limit indicates greater publication bias, and the more symmetrical distribution of studies on both sides of the vertical line indicate a smaller publication bias

Discussion

Primary fixation with a cementless cup is essential for achieving a mechanical environment that allows secondary fixation by bone ingrowth. Excessive micromotion at the bone–implant interface may promote fibrous tissue formation instead of the desired bone ingrowth and subsequently leads to early implant loosening [17]. Transacetabular screw fixation is widely used because of its reliable stability [18] despite potential neurovascular injury or fretting corrosion [19]. Achieving stability between acetabular component and bone is the most important factor in maximising bony ingrowth into porous surfaces. The development of osteolytic lesions is believed to be the result of transmission of articular pressure and wear particles to the acetabular bone via screw channels [20]. However, according to our analysis, a screw does not increase osteolytic lesions. Now that ceramic-coated press-fit

cups are widely used [21], wear particles are fewer than those created by a polyethylene liner.

Loss of implant fixation continues to be the most frequent and significant complication of total joint arthroplasty. According our analysis, there was no statistically significant difference between THAs with and without screws in relation to migration or loosen or between the two surgical methods in reoperation or revision rate.

There are certain limitations in this meta-analysis. Firstly, only five studies were included in this analysis. Furthermore, of the five studies, only three were RCTs, whereas the remaining two were not. However, our study also has several strengths. We took sensitivity analysis by exchanging effects models, publication bias was analysed using the funnel plot, and—importantly—there is no other meta-analysis published in the literature regarding fixation of acetabular cups with and without screws.

In general, there was no statistically significant difference between the two surgical methods in reoperations, migration and osteolysis according to our analysis of the five studies. A greater number of high-quality studies are needed to demonstrate the difference between cementless acetabular fixation with and without screws in THA.

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Declaration of interests The authors declare no conflict of interest.

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