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Postoperative Deep Infection After Cemented Versus Cementless Total Hip Arthroplasty: A Meta-Analysis

Byung-Ho Yoon, MD [b], Yong-Chan Ha, MD [c], Young-Kyun Lee, MD [a], Kyung-Hoi Koo, MD [a]

[a] Department of Orthopaedic Surgery, Seoul National University Bundang Hospital, Seongnam, South Korea
[b] Department of Orthopaedic Surgery, Inje University College of Medicine, Seoul Paik Hospital, Seoul, Korea
[c] Department of Orthopaedic Surgery, Chung-Ang University College of Medicine, Seoul, South Korea

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ABSTRACT

Periprosthetic joint infection (PJI) is a serious complication of total hip arthroplasty (THA). The objective of this meta-analysis was to compare the PJI rate between cemented and cementless THAs. Eight clinical studies (2 randomized controlled trials and 6 observational studies) were available for the analysis. Meta-analysis (with a fixed-effects model) and subgroup analysis were performed by research design and meta-regression was performed by continuous moderator. The overall incidence of PJI was 0.4% (357/84,200). The incidence was 0.5% (310/67,531) in cemented group, and 0.3% (47/16,669) in cementless group ($P = 0.008$). The meta-analysis revealed that the use of cement in THA was associated with an increased risk of PJI (odds ratio 1.53; 95% confidence interval 1.120 to 2.100; $P = 0.008$).

Total hip arthroplasty (THA) is an effective surgical treatment for arthritic diseases of the hip joint [1]. Although both cemented and cementless methods afford satisfactory fixation, there has been a concern regarding complications of each method [2].

Bone cement has been used in THA for over 5 decades. Although the cemented fixation provides an immediate strong interlock between implant and bone tissue and allows an early weight bearing, it is associated with a risk of cement-related adverse events such as cardiopulmonary complications [3–5].

Cementless fixation was introduced in 1970s. Early studies indicated that the rates of wear and osteolysis associated with cementless acetabular components were greater than those of cemented cups [6]. In recent studies, the wear and osteolysis were not significantly associated with methods of cup fixation [7,8]. Periprosthetic bone loss of the proximal femur by wear particles was also a serious problem after the use of earlier stem designs but, cementless stems with a close proximal fit and circumferential coating were associated with much lower rate of the periprosthetic bone loss and excellent long-term survivorship [9–13].

Several studies have compared short-term complications such as cardio-vascular events and long-term survivorship between cemented and cementless THAs using meta-analysis [14,15]. Perioperative joint infection (PJI) is one of the most serious complications of THA. The incidence of PJI after primary THA ranges from 0.7% to 2.1% [16–19]. However, there is no meta-analysis comparing the PJI incidence between cemented and cementless THAs. Because the incidence is low by number, a meta-analysis of PJI should be based on well-designed studies, which provide sufficient statistical power [15].

The purpose of this meta-analysis study was to evaluate whether the use of cement increases the risk of PJI after primary THA.

Materials & Methods

This meta-analysis included original studies based on the following criteria; (1) published as an original article in English, (2) compared cemented THA (cement used in both cup and stem) and cementless THA (cement not used in both cup and stem), (3) evaluated the periprosthetic joint infection in patients who underwent surgery. All randomized controlled trials and comparative observational studies with a control group were included.

Studies were identified by searching PubMed, Embase and Cochrane Library. The following search terms were used for the literature search of the PubMed database: ("Hip"[Mesh] OR "hip"[All Fields] OR "Hip Joint"[Mesh]) AND ("arthroplasty"[MeSH Terms] OR "arthroplasty"[All Fields]) AND ("bone cements"[Mesh Terms] OR "bone cement"[All Fields] OR "cemented"[All Fields]) AND ("cementless"[All Fields] OR "uncemented"[All Fields]) AND "English"[language]. The studies identified were then filtered to limit the search to publications from 1980 to 2013. The following keywords were used for the other databases: 'hip', 'replacement', 'arthroplasty', 'bone cement', 'cementless or uncemented'.

After screening the studies identified by the search, the full manuscript of each article was retrieved to assess the eligibility of study. One of the authors reviewed the retrieved full manuscripts to determine

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Reprint requests: Young-Kyun Lee, MD, Department of Orthopaedic Surgery, Seoul National University Bundang Hospital, 166 Gumi-ro, Bundang-gu, Seongnam,463-707, South Korea.

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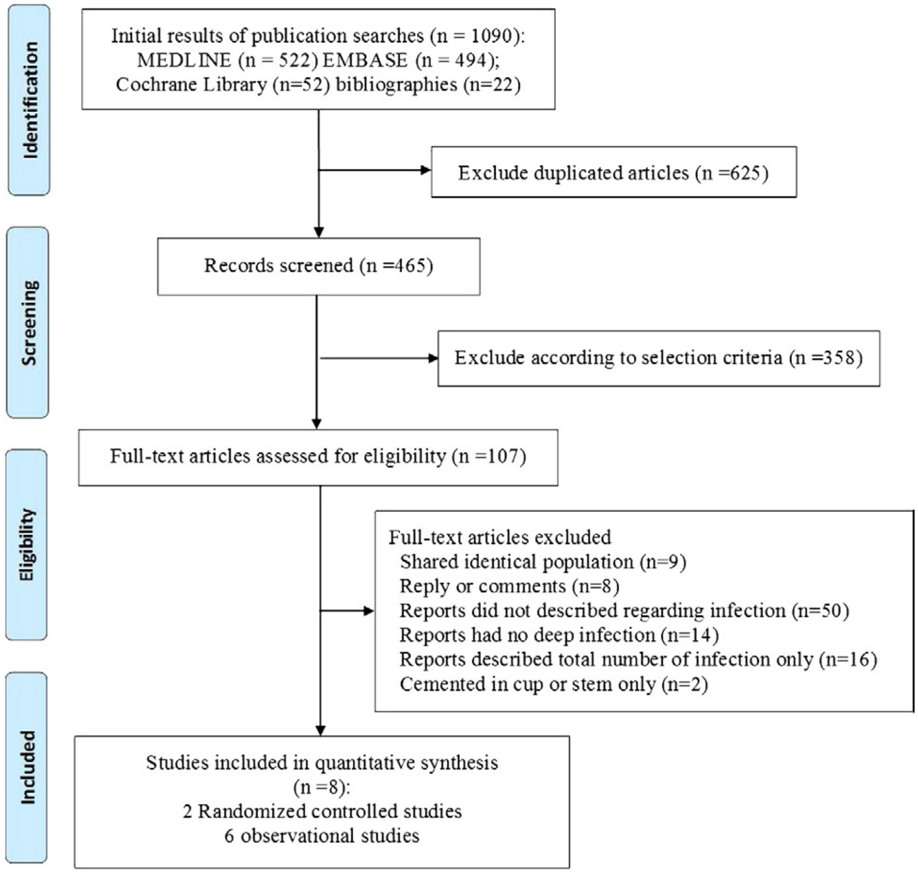

Fig. 1. PRISMA Flow diagram describing the selection process for relevant clinical trials used in this meta-analysis.

whether PJI after surgery had been evaluated in the full manuscript. Letters, editorials, correspondence and review articles were excluded. Finally, only original studies with a comparative design were selected.

Two observers independently reviewed data on year of publication, study design, number of hips treated with hip arthroplasty, the type of implant, use of bone cement, status of antibiotic loading in bone cement, mean length of follow-up and number of hips lost to follow-up of the identified articles. Various definitions have been proposed for PJI and each study adopted different diagnostic criteria of PJI. Thus, we counted revisions due to infection or septic loosening as PJI [20].

For each study, we calculated the odds ratio with 95% confidence intervals using crude 2×2 tables on the basis of intention to treat analysis from the original publications [21]. We used the Mantel–Haenzel method to calculate the pooled odds-ratio due to zero values in any cell count in a table [22]. For the test of heterogeneity, we used Higgins I^2 statistics, and there was no significant heterogeneity ($P = 0.777$, $I^2 = 0.00$) in these studies. Thus, we analyzed the data by using a fixed-effect model. We also performed subgroup meta-analyses by type of methodological quality (randomized controlled trial versus observational study). Meta-regression was used to evaluate the association between study results and continuous moderators (year of publication). A P value of less than 0.05 was considered significant. To assess publication bias, Begg's funnel plot was used. If publication bias exists, the Begg's funnel plot is asymmetric. There are several limitations in studies based on registry data such as not-standardized follow-up and outcome evaluation [23]. Thus, we performed a sensitivity analysis by excluding studies that used registry data. Comprehensive Meta-analysis software (version 2.2. Biostat, Englewood, NJ) was used for the analysis.

This study was exempted from institutional review board (IRB) review because it did not involve human subjects.

Source of Funding

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Results

Based on the above search strategy, a total of 1090 published were searched for comparison of cemented and cementless fixation in THA. Of these 1090 articles, 1065 were excluded because the papers did not compare the results between cemented and cementless THA, and 17 were excluded because they were not original articles. The remaining 8 studies that included two registry studies were analyzed (Fig. 1) [24–31].

There were 84,200 hips included in the 8 studies: 67,531 hips in the cemented group and 16,669 hips in the cementless group (Table 1). The overall incidence of PJI was 0.4% (357/84,200). The incidence was 0.5% (310/67,531) in cemented group, and 0.3% (47/16,669) in cementless group ($P = 0.008$).

In the fixed effects model for all 8 studies, the use of cement was associated with an increased risk of PJI (odds ratio 1.53; 95% confidence interval 1.120 to 2.100; $P = 0.008$). In the sensitivity analysis of the 2 registry studies, the results were homogenous (Fig. 2).

There was a significant publication bias with asymmetrical Begg's funnel plot (Fig. 3). However, after trimming by imputing the missing studies, adding them to the analysis, and then recomputing the effect size (Duval and Rweedie's trim and fill method), the odds ratio did not changed significantly (from 1.53 to 1.42). In the meta-regression between study results and year of publication, there was no significant difference. We found no significant association between odds-ratio and the study designs (Table 2).