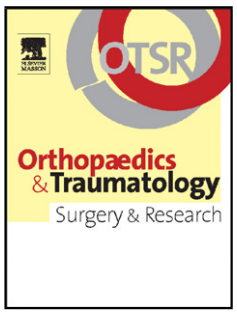


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Original article

# Total Hip Arthroplasty After a Previous Pelvic Osteotomy: A Systematic Review and Meta-analysis

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**Abstract**

Background:

There are several reports regarding total hip arthroplasty (THA) after a previous pelvic osteotomy (PO). However, to our knowledge, until now there has been no formal systematic review and meta-analysis published to summarize the clinical results of THA after a previous PO. Therefore, we conducted a systematic review and meta-analysis of results of THA after a previous PO. We focus on these questions as follows: does a previous PO affect the results of subsequent THA, such as clinical outcomes, operative time, operative blood loss, and radiological parameters.

Methods:

Using PubMed, Web of Science, and Cochrane Library, we searched for relevant original papers. The pooling of data was performed using RevMan software (version 5.3, Cochrane Collaboration, Oxford, UK). $P<0.05$ was judged as significant. Standardized mean differences (SMD) were calculated for continuous data with a 95% confidence interval (CI) was reported. Statistical heterogeneity was assessed based on $I^2$ using standard $\chi^2$ test. When $I^2>50\%$, significant heterogeneity was assumed and a random-effects model was applied for the meta-analysis. A fixed-effects model was applied in the absence of significant heterogeneity.

Results:

Eleven studies were included in this meta-analysis. The pooled results indicated that there was no significant difference in postoperative Merle D'Aubigne-Postel score ($I^2$=0%, SMD=-0.15, 95% CI: -0.36 to 0.06, $P$=0.17), postoperative Harris hip score ($I^2$=60%, SMD=-0.23, 95% CI: -0.50 to 0.05, $P$=0.10), operative time ($I^2$=86%, SMD=0.37, 95% CI: -0.09 to 0.82, $P$=0.11), operative blood loss ($I^2$=82%, SMD=0.23, 95% CI: -0.17 to 0.63, $P$=0.25), and cup abduction angle ($I^2$=43%, SMD=-0.08, 95% CI: -0.25 to 0.09, $P$=0.38) between THA with and without a previous PO. However, cup anteversion angle of THA with a previous PO was siginificantly smaller than that of without a previous PO ($I^2$=77%, SMD=-0.63, 95% CI: -1.13 to -0.13, $P$=0.01).

Conclusion:

Systematic review and meta-analysis of results of THA after a previous PO was performed. A previous PO did not affect the results of subsequent THA, except for cup anteversion. Because of the low quality evidence currently available, high-quality randomized controlled trials are required.

Keywords: Total hip arthroplasty; pelvic osteotomy; systematic review; meta-analysis

**Level of evidence:** level III, meta-analysis of case control studies.



## 1. Introduction

Pelvic osteotomy (PO) is a treatment option for acetabular dysplasia (AD) in young adults that can reduce the risk of osteoarthritis (OA) or its progression in hip joints. Many satisfactory long-term results of POs have been reported [1-14]. For some patients, progression of OA occurs in the long-term despite a PO, thereby necessitating a subsequent total hip arthroplasty (THA). Several reports have evaluated THA after a previous PO. Parvizi et al. [15] reported that a previous PO does not compromise the results of THA. Hartig-Andreasen et al. [16] reported excellent clinical results of THA after a previous PO. In contrast, Osawa et al. [17] concluded that the therapeutic outcomes and cup positioning for THA after a previous PO were poorer compared with those of a primary THA. Whether or not a previous PO affects the result of a subsequent THA remains controversial, particularly when considering the limited size of each study, justifying a systematic literature review and meta-analysis to clarify this controversy. Therefore we conducted a systematic review and a meta-analysis of the results obtained for THA after PO. We focus on these questions as follows: does a previous PO affect the results of subsequent THA, such as clinical outcomes, operative time, operative blood loss, and radiological parameters. We defined PO as osteotomy performed pelvic bone for treatment of AD or OA of hip joint, and included Bernese periacetabular osteotomy (BPO), rotational acetabular osteotomy (RAO), Chiari osteotomy (CO), Salter osteotomy (SO), shelf acetabuloplasty (SA), triple innominate osteotomy (TIO), and Wagner spherical osteotomy (WSO) in this study.

## 2. Materials and Methods

This study followed the guideline of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses statement [18]. Ethical approval for this study was deemed unnecessary because it was a systematic review and meta-analysis of the existing literature and did not involve the handling of any individual patient data.

### 2.1 Search Strategy

We systematically searched PubMed, the Web of Science, and the Cochrane Library electronic databases for relevant articles reporting study results on August 30, 2017. The following search terms were used: ('total hip arthroplasty' OR 'total hip replacement' OR 'THA' OR 'THR' OR 'hip prosthesis') AND ('osteotomy' OR 'osteotomies') AND ('pelvis' OR 'pelvic' OR 'acetabular' OR 'acetabulum'). We also checked the reference lists in the retrieved articles to include additional studies that met the criteria but were not found by the electronic search. All identified articles were individually assessed for inclusion.



### 2.2 Eligibility Criteria

Articles were considered for selection if they met the following eligibility criteria: (1) a randomized clinical trial (RCT), a case-control study or a cohort study; (2) patients were in an experimental group that underwent THA after a previous PO, or if patients were in a control group that underwent primary THA without a previous PO; (3) reports included data for surgical outcomes, clinical outcomes, and radiological parameters. We defined PO as osteotomy performed pelvic bone for treatment of AD or OA of hip joint, and included BPO, RAO, CO, SO, SA, TIO, and WSO in this study. Duplicate publications were excluded, as were articles written in languages other than English. Reviews, letters, comments, meeting proceedings, editorials, practice guidelines, and studies reporting insufficient data were considered unsuitable. Articles reporting studies in which patients in an experimental group had undergone THA after a previous femoral osteotomy (FO) only were excluded; although articles of studies in which patients in an experimental group had undergone THA after a previous FO with a PO were included.

### 2.3 Data Extraction

Two authors independently scanned the titles and abstracts of potential articles. The full text of potential articles that met the eligibility criteria were further screened and a final decision regarding their relevance was made. Any discord regarding the relevance of a potential study was resolved via a discussion to reach a consensus about its inclusion.

The following data were extracted from selected articles of studies: (1) first author names, published year, and country; (2) demographic characteristics of the participants including the type of osteotomy, gender, interval from PO to THA, age, and follow-up period after THA; (3) surgical outcomes for the meta-analysis including clinical outcomes, operative time, operative blood loss, and radiological parameters.

### 2.4 Outcome Measures

Primary outcomes were clinical outcomes included postoperative Harris hip score (HHS) [19] or Merle d'Aubigne-Postel (PMA) score [20]. Secondary outcomes included operative time, operative blood loss, and radiological parameters. Radiological parameters included cup abduction angle and cup anteversion angle.

### 2.5 Quality Assessment

Study quality was judged by using the Jadad five-point scale [21] for RCTs and the Newcastle-Ottawa Scale (NOS) [22] for non- RCTs. The Jadad five-point scale contained two questions each on randomization and masking and one question on the reportion of dropouts and withdrawals. The NOS assesses population selection, comparability of exposed and unexposed, and adequacy of outcome assessment (including outcome ascertainment and attrition).

### 2.5 Statistical Analysis

Data were pooled using RevMan software (version 5.3, Cochrane Collaboration, Oxford, UK). $P<0.05$ was judged as significant. Standardized mean differences (SMD) were calculated for continuous data with a 95% confidence interval (CI) was reported. Statistical heterogeneity was assessed based on $I^2$ using standard $\chi^2$ test. When $I^2>50\%$, significant heterogeneity was assumed and a random-effects model was applied for the meta-analysis. A fixed-effects model was applied in the absence of significant heterogeneity. For studies that



reported continuous variables with ranges instead of the standard deviation (SD), we estimated the SD using the Walter method [23]. We planned to perform subgroup analysis for the outcomes by grouping studies on the type of PO. Sensitivity analysis was also performed.

## 3. Results

### 3.1 Search Results

A preliminarily review of 1213 articles sourced from the database searches was conducted. Of those articles, 340 comprised studies that were excluded because of duplication. Among the remaining 873 articles, a further 848 were excluded after screening the titles and abstracts. Of the remaining 25 articles, 15 were excluded from the current meta-analysis following a full article review that considered the eligibility criteria. One article from the reference review was deemed eligibility for inclusion. No grey reference was obtained. No RCT was included in this study. After all screening processes, 11 studies [17,24-33] were included in the assessment of methodological quality in this review. A flowchart showing the inclusion process for articles is shown in Figure 1.

### 3.2 Patient Characteristics Based on Studies

Among all the articles selected from our searches, 11 of them reported studies deemed eligible for inclusion in a meta-analysis. Six of the 11 selected studies were performed in Japan, 2 were conducted in the United States of America, and 1 was performed in each of the following countries: the United Kingdom, Serbia, and France. More detailed information is summarized in Table 1.

### 3.3 Quality assessment

The Newcastle Ottawa Scale (NOS) was used to assess the 11 eligible studies. All the articles were scored according the three sections of NOS (selection, comparability and assessment of outcome). NOS scores were shown in Table 2.

### 3.4 Primary Outcomes

Three articles (451 hips) [26,28,32] reported postoperative PMA score. There was no significant heterogeneity ($I^2$=0%), therefore the fixed-effects model was used. Pooling the data showed that there was no significant difference in postoperative PMA score between the THA with and without a previous PO (SMD=-0.15, 95% CI: -0.36 to 0.06, $P$=0.17), as shown in Figure 2. Six articles (672 hips) [17,25,27,28,30,31] reported the postoperative HHS. There was significant heterogeneity ($I^2$=60%), therefore the random-effects model was used. Pooling the data showed that there was no significant difference in postoperative HHS between THA with and without a previous PO (SMD=-0.23, 95% CI: -0.50 to 0.05, $P$=0.10). A subgroup analysis of two articles (204 hips) [17,30] showed that there was significant difference in postoperative HHS between THA with a previous RAO and without a previous PO (SMD=-0.62, 95% CI: -0.92 to -0.33, $P$<0.0001). A subgroup analysis of two articles (171 hips) [25,27] showed that there was no significant difference in postoperative HHS between THA with a previous CO and without a previous PO (SMD=0.04, 95% CI: -0.26 to 0.35, $P$<0.79), as shown in Figure 3.

### 3.5 Operative time