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Cemented versus cementless bipolar hemiarthroplasty for femoral neck fractures in the elderly

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- The management of femoral neck fractures remains controversial. Treatment options include a wide variety of internal fixation methods, unipolar or bipolar hemiarthroplasty or total hip replacement.
- We carried out a systematic review of the available literature to detect differences between cemented and cementless fixation of bipolar prostheses in treating femoral neck fractures in patients aged 60 years or older.
- Thirteen studies involving a total of 1561 bipolar hemiarthroplasties (770 cemented and 791 uncemented) were identified. Uncemented hemiarthroplasty was associated with significantly lower blood loss ($p < 0.0001$), shorter operative time ($p < 0.0001$), less infection ($p = 0.03$) and lower risk of heterotopic ossification ($p = 0.007$). On the other hand, patients with cemented hemiarthroplasty suffered significantly less postoperative thigh pain than those with cementless implantation ($p < 0.00001$).
- The existing evidence indicates that uncemented bipolar hemiarthroplasty offers shorter operative time, less blood loss, lower local complications and a similar rate of systemic complications and reoperations as compared to cemented implantation.

Keywords: bipolar hip prostheses; cemented hemiarthroplasty; femoral neck fracture; meta-analysis; systematic review; uncemented hemiarthroplasty

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Introduction

Fractures of the femoral neck are common in the elderly and can significantly increase mortality, decrease mobility and increase the health cost.[1,2] They account for nearly 50% of hip fractures.[3] Treatment options include a wide variety of internal fixation methods, hemiarthroplasty or total hip replacement. The case for arthroplasty was strengthened by the use of bone cement that allows early mobilization of the fractured, elderly and morbid patients. The aims of treatment are pain relief, early mobilization and maintenance of the patient's independence.[1,2,4]

Hemiarthroplasty is a widespread surgical treatment of displaced femoral neck fractures in older people. Two implant categories are available, either a unipolar or a bipolar hemiarthroplasty.[5] Traditionally, cemented implantation is mostly preferred in elderly patients. However, later studies showing promising results using cementless fixation have been reported. In this work, we aimed to conduct a systematic review with meta-analysis to detect differences in outcome between cementless and cemented bipolar arthroplasty in femoral neck fractures in elderly patients as regards blood loss, mortality rate, operative time, hospital stay, dislocation rate and complications using the best available evidence. Only studies with bipolar hemiarthroplasty were analysed, excluding cases treated with unipolar prostheses or total hip replacement.

Materials and methods

We searched PubMed, Embase, MEDLINE and Cochrane Library for papers in English language comparing cemented to uncemented bipolar arthroplasty in treating femoral neck fracture in patients aged 60 years or older. Two reviewers independently performed an electronic search of the literature from inception to 31 December 2015 using these search terms: uncemented hemiarthroplasty, cemented hemiarthroplasty, femoral neck fracture, elderly, unipolar or bipolar, hip fractures, hip fracture, femoral neck fracture*, femoral neck fractures*, intracapsular hip fracture*, intracapsular neck fracture*, arthroplasty, arthroplast*, hemiarthroplasty* and bipolar prosthes*. Terms were connected by "AND" and "OR". This was supplemented with manual searches of the retrieved studies. We reviewed titles and abstracts first and then decided potentially whether the paper was eligible

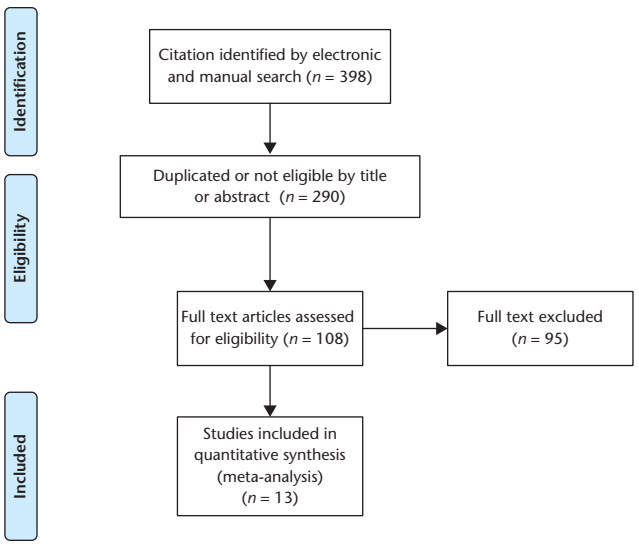

Fig. 1 PRISMA flow chart of the study.

or not. We then carefully analysed the full texts of these studies according to the inclusion criteria and extracted the relevant clinical and research data.

The eligibility criteria for this meta-analysis were papers comparing cementless and cemented bipolar arthroplasty in femoral neck fractures in elderly patients. The exclusion criteria included personal communications, unpublished data, clinical trials under research, studies with unipolar prostheses, total hip replacement or non-identified prosthetic implants as well as papers without an English abstract. Two researchers independently extracted the following data: mortality rate, blood loss, operative time, length of hospital stay, postoperative myocardial infarction, postoperative pneumonia, pulmonary embolism, postoperative infection, dislocation rate, heterotopic ossification and postoperative thigh pain. Statistical significance was set at a p-value of $p \leq 0.05$ with a confidence interval of 95%.

Results

Thirteen studies[6–18] involving a total of 1561 bipolar hemiarthroplasties were eligible for this meta-analysis (Fig. 1). There were 770 cemented and 791 uncemented implantations in patients aged 60 years or older. The decision for cemented or cementless fixation was according to randomization in six prospective randomized controlled trials. In the rest, it was according to surgeon's preference. In all selected studies, both groups were matched in terms of age, gender, fracture pattern, associated comorbidities according to the preoperative American Society of Anesthesiologists (ASA) scores and preoperative ambulatory status to avoid selection bias.

Mortality (from 6 months to 19 months) was discussed in eight studies (519 cemented and 474 uncemented hemiarthroplasties). There were 166 deaths in cemented (32%) and 138 (29%) in uncemented implantations. Although this meta-analysis demonstrated more mortality with cemented implantation, the difference was, however, not statistically significant ($p = 0.36$).

Blood loss data (Fig. 2) were provided in four studies, with 234 cemented and 245 uncemented prostheses. The average blood loss was 362 ml in the cemented group and 288 ml in the uncemented group. The lower blood loss in uncemented hemiarthroplasty was statistically significant ($p < 0.0001$).

The operative time (Fig. 3) was provided in eight studies. The total number of cemented hemiarthroplasties was 509 and uncemented hemiarthroplasties was 590. Meta-analysis results demonstrated less operative time in uncemented hemiarthroplasty (mean: 71 minutes) compared to cemented hemiarthroplasty (mean: 86 minutes). The difference was statistically significant ($p < 0.0001$).

As regards the length of hospital stay (LOS), information was provided in nine studies with a total of 625 cemented and 643 cementless prostheses. The average hospital stay for cemented arthroplasty was 16.27 days for cemented and 16.17 for uncemented hemiarthroplasty without significant differences between the groups ($p = 0.27$).

Postoperative infection data (Fig. 4) were provided in 10 studies. The total number of cemented replacements was 619 cases and of uncemented arthroplasty was 705 cases. The postoperative infection rate for cemented was 3.8% ($n = 24$) and for uncemented was 2.2% ($n = 16$). The difference was statistically significant ($p = 0.03$) with an odds ratio of 1.96.

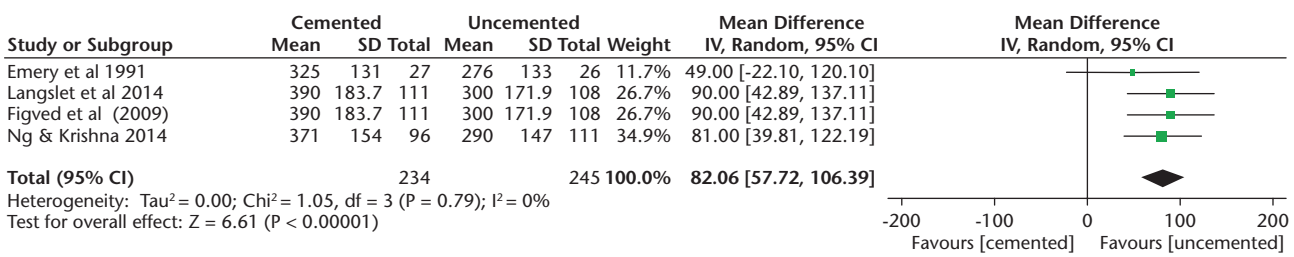

Fig. 2 Blood loss in cementless and cemented hemiarthroplasty.

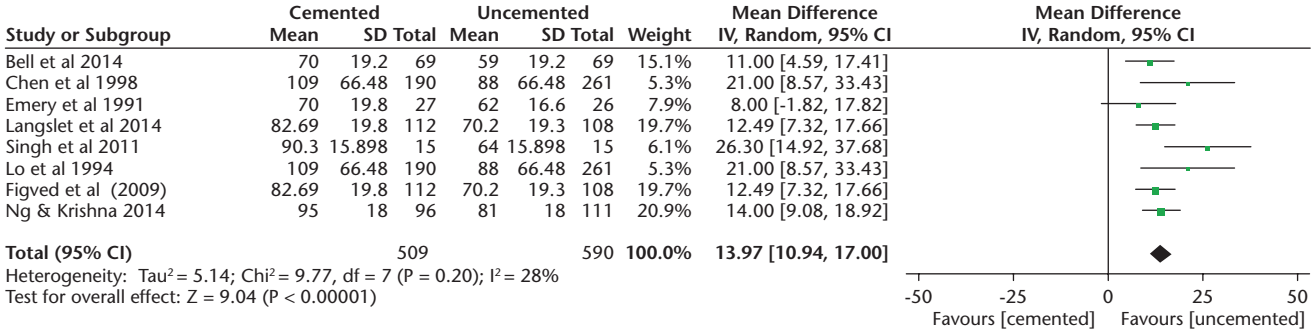

Fig. 3 Difference in operative time between cemented and uncemented bipolar hemiarthroplasty.

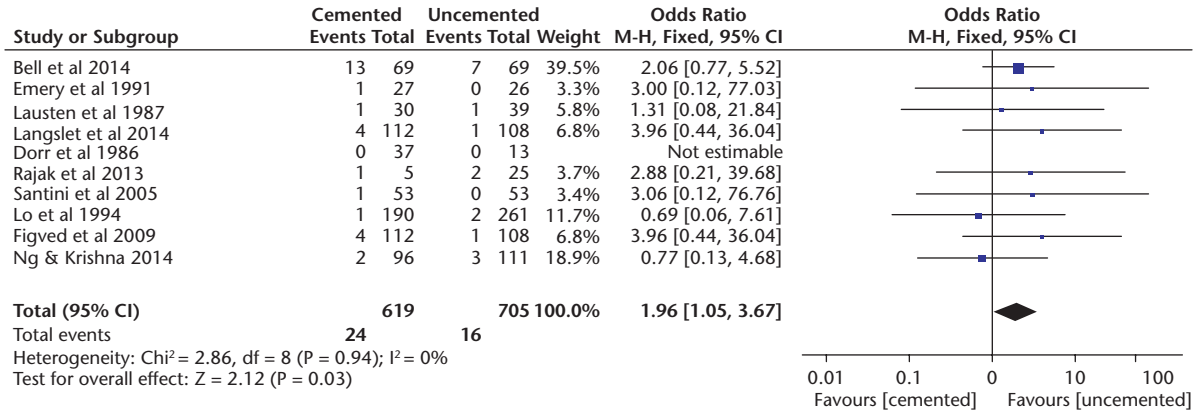

Fig. 4 Comparison between cemented and uncemented arthroplasty in postoperative infection.

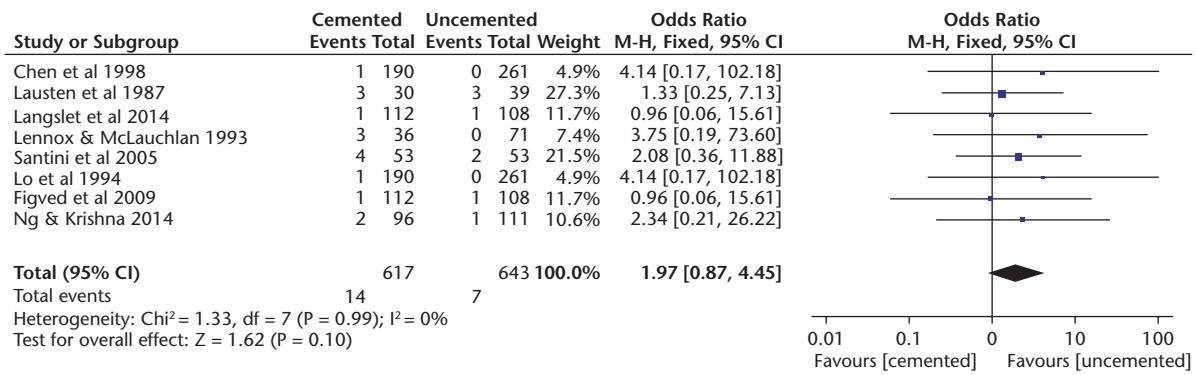

Fig. 5 Myocardial infarction after bipolar hemiarthroplasty in femoral neck fractures.

In the eight studies that described the incidence of postoperative pneumonia, 21 patients with cemented hemiarthroplasty and 29 patients with uncemented hemiarthroplasty were described, with a rate of 4% in the cemented group (total: 523) and 6% in the uncemented group (total: 477). Meta-analysis results demonstrated no statistical difference (p = 0.29). Additionally, eight studies discussed the rate of postoperative myocardial infarction after bipolar hemiarthroplasty in femoral neck fractures (Fig. 5). These also showed no statistically significant difference (p = 0.1) between cemented and cementless implantations (2% and 1% respectively). As regards pulmonary embolism, nine out of 718 patients with cemented implantation (1.2%) developed postoperative pulmonary embolism compared to seven patients out of 763 with uncemented implantation (0.9%). The difference was again not statistically significant (p = 0.32).

Dislocation occurred in 13 out of 706 cemented (1.8%) and in 10 out of 752 uncemented bipolar hemiarthroplasties (1.3%). These were the studies that provided data

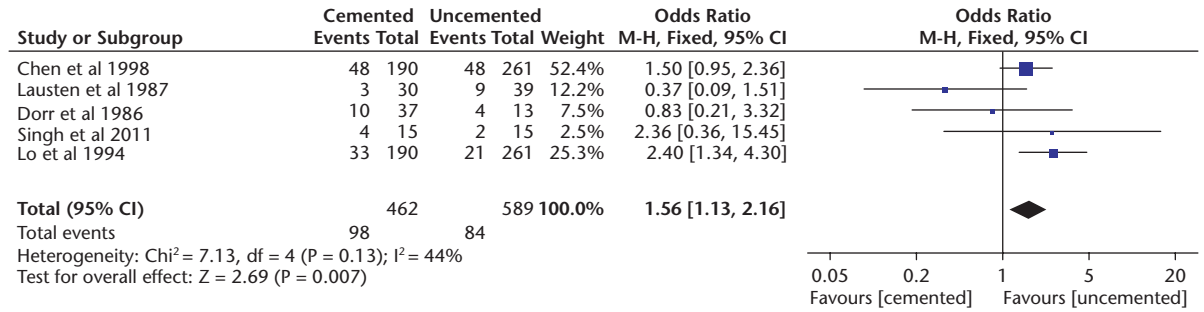

Fig. 6 Heterotopic ossification after bipolar hemiarthroplasty (cemented and uncemented).

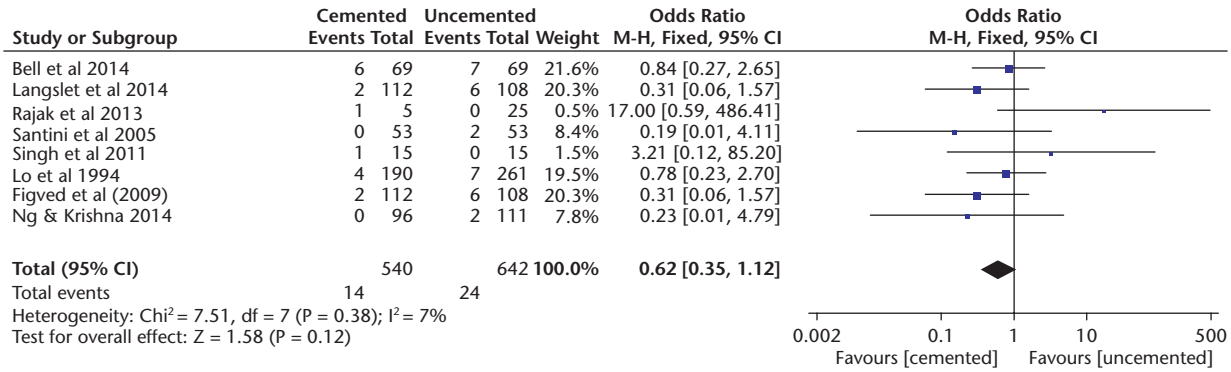

Fig. 7 Latrogenic femoral fractures after cemented vs. cementless hemiarthroplasty.

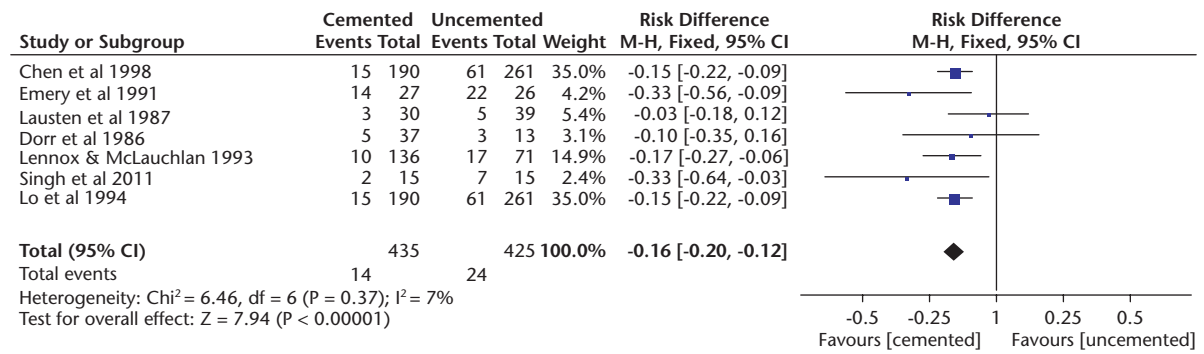

Fig. 8 Thigh pain after bipolar hemiarthroplasty.

about postoperative dislocation (n = 10 studies). The difference was not significant (p = 0.54).

The incidence of heterotopic ossification after bipolar hemiarthroplasty was studied in five series with a total number of 272 cemented and 328 uncemented implantations (Fig. 6). Ninety-eight patients developed heterotopic ossifications in the cemented group (21%) as compared to 84 patients in the uncemented group (14%). The difference was statistically significant (p = 0.007) with an odds ratio of 1.56.

Iatrogenic femoral fractures (Fig. 7) occurred in 14 patients out of 540 cemented bipolar hemiarthroplasties (2.6%) and in 24 patients out of 642 uncemented bipolar hemiarthroplasties (3.7%) in the eight studies that dealt with this complication (odds ratio 0.62). The difference was not statistically significant (p = 0.12).

Forty-nine patients with cemented hemiarthroplasties complained of postoperative thigh pain from a total of 435 patients (11%). On the other hand, 115 patients from 425 cases treated with cementless hemiarthroplasty (27%) developed thigh pain after implantation (Fig. 8). The difference was statistically highly significant (p < 0.00001).

Although there was a tendency for more reoperations after uncemented hemiarthroplasty (6.4%) in comparison to cemented implantation (4.5%) in seven studies with a total number of 549 cemented and 547 uncemented

replacements, the difference between both groups was still not statistically significant (p = 0.07).

Discussion

Bipolar hemiarthroplasty is considered the treatment of choice for displaced femoral neck fractures in elderly patients. Cemented fixation is an established procedure for the mobile elderly. Cement pressurization, however, raises the intramedullary pressure and may cause fat embolism and fatal bone cement implantation syndrome, especially in patients with several comorbidities.[5] Cementless implantation yields lower intramedullary pressures with less embolization and less hemodynamic imbalance. This may decrease the mortality rate but is technically demanding and needs thorough planning and precise execution.[6] Previous trials comparing cemented and uncemented hemiarthroplasty have reported contradictory results.[15-21] Therefore we carried out this systematic review to detect evidence-based differences in outcome and complications between cementless and cemented bipolar hemiarthroplasty in femoral neck fractures in elderly patients.

In general, postoperative mortality in elderly patients undergoing surgery for femoral neck fractures is high.[22,23] Our meta-analysis showed, however, no statistically significant difference in the mortality rate between cemented and cementless hemiarthroplasty. This agrees with the meta-analysis by Li et al, who analysed seven studies involving 1125 patients and found no significant difference between groups in the perioperative mortality and up to one year postoperatively.[24] Other studies showed that bone cement might increase the mortality rate by inducing cerebrovascular complications and cardiovascular events.[23,25,26,27] One study reported that one patient experienced severe hypotension during the cementing procedure and died within 24 hours of myocardial infarction and another developed intraoperative cardiac arrest during wound closure.[8] Others reported similar mortality rates at 12 months follow-up in both groups.[17,18] Old age, reduced preoperative cardiopulmonary function and physical reserves were identified as risk factors for higher mortality.[22]The significantly lower rates of blood loss and infection in the uncemented group are probably attributable to the significantly shortened operative time in this group. This difference is related to the cementing time, and it may differ according to the surgeon's skills. Previous studies similarly reported a longer operation time in patients with cemented stems.[7,8,16] Figved et al[8] and Ng and Krishna[12] reported a higher intraoperative bleeding volume in the cemented group. On the other hand, Park et al[28] reported that the postoperative blood loss volume was significantly higher in the uncemented group. A haemostatic effect of cement insertion to the femoral canal is suggested, but further investigation is needed to clarify its exact mechanism.

Our study showed no significant difference in systemic complications between both groups. This agrees with the meta-analysis by Li et al, which reported no significant difference between groups in cardiovascular and cerebrovascular complications.[24] Further studies also showed no significant differences in complications, indicating that cement plays little, if not no, role in local and general complications.[19,25]

As regards implant-related complications, we found a lower risk of dislocation and heterotopic ossification with uncemented implantations. On the other hand, the risk of iatrogenic femur fractures was higher in the uncemented group, yet without statistical significance. Implant-related complications were also described in three studies,[13,21,29] which all reported significantly more implant-related complications in the cementless group. We also found no significant difference regarding the reoperation rate despite more tendency with cementless implantation. This agrees with the results described in other studies.[13,29] Only Taylor et al found significantly lower implant-related complications in patients aged 70 years or older treated with cementless implants.[21]

Our meta-analysis demonstrated significantly less postoperative thigh pain in the cemented group. Ng and Krishna reported the same results as ours.[12] Also, further meta-analysis of Li et al and Luo et al showed that cemented hemiarthroplasty offered better clinical outcomes and less thigh pain compared to cementless stems.[24,30] On the other hand, Taylor et al[21] reported no difference in postoperative thigh pain and walking ability between groups.

Our study is limited by the relatively small number of cases involved in this meta-analysis considering the high incidence of femoral neck fractures in elderly patients. Also, despite having matched cemented and cementless groups in all selected studies, only half were randomized as regards the fixation method, amounting for a potential selection bias. Furthermore, the total number of complications was based on the complications reported in the included studies. Possible differences in the definition of a complication or the length of follow-up might influence the complication rate, particularly for late complications such as loosening and osteolysis. Additionally, the difference in follow-up times and the different functional outcomes make it difficult to pool some data. Despite these limitations, our study adds to the literature, as systematic reviews with meta-analysis represent the best available evidence to compare cemented and cementless bipolar hemiarthroplasty in femoral neck fractures.

In conclusion, the existing evidence indicates that uncemented bipolar hemiarthroplasty is associated with a

shorter operative time, less blood loss and less risk of infection and heterotopic ossification compared to cemented implantation with no significant difference as regards other postoperative local or systemic complications or the reoperation rate. Thigh pain, however, remains a concern in cementless fixation. There remains a need for a methodologically sound, large multicentre randomized controlled trial comparing modern cemented and cementless hemiarthroplasty stems in the medium and long term, not only focusing on mortality and complication rates but also on patient-reported outcome measures (PROMs).

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ICMJE CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest relevant to this work.

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