



UMEÅ UNIVERSITET

Umeå University Medical Dissertations, New Series No 2019

The Uncemented Cup in Total Hip Arthroplasty Stability, Wear and Osteolysis

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Akademisk avhandling

som med vederbörligt tillstånd av Rektor vid Umeå universitet för
avläggande av medicine doktorsexamen framläggs till offentligt
försvar i Sal B, trapphus A, 9tr, Norrlands universitetssjukhus
fredagen den 12 april, kl. 13:00.

Avhandlingen kommer att försvaras på svenska.

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Author Volker Otten**Title** The Uncemented Cup in Total Hip Arthroplasty *Stability, Wear and Osteolysis***Abstract**

Background: Artificial hip joint replacement has undergone tremendous development in the past 100 years. In the beginning, complications, such as infection and early loosening, were the rule rather than the exception. Today, complications of any sort are rare during the first decade after the operation. Artificial hip joint replacement has been chosen as the "Operation of the Century" and has dramatically improved the quality of life of millions of patients. Unfortunately, in the long-term, prosthesis loosening due to pathological bone resorption (osteolysis) around the prosthesis is still common. Traditionally, the prosthesis is anchored in the bone with bone cement (Plexiglas). However, since this cementation method was suspected to cause late loosening, alternative methods, such as the implantation of so-called uncemented prostheses, have been developed and are being increasingly applied. Because the early movement of a prosthesis (migration) increases the risk of loosening, uncemented cups are often augmented with additional screws. The mechanisms regulating the early and late loosening of uncemented cups are not fully established. Wear particles from the artificial joint and intermittent fluid pressure on the bone appear to accelerate or even cause bone loss and can eventually lead to loosening of the prosthesis. Therefore, screw holes in the uncemented cup have been suspected to be a risk factor.

Aims: We have studied whether the additional augmentation of modern uncemented cups with screws, pegs or hydroxyapatite increases the long-term stability, affects the wear rate, influences the development of osteolysis, or has any impact on the risk of cup revision. Furthermore, we investigated whether computed tomography (CT), which is needed to detect osteolysis around the prosthesis, could also be used in the follow-up of migration studies without losing significant precision compared to radiostereometry (RSA), which is the gold standard for these measurements.

Patients and Methods: In studies I-III, we evaluated 48 hips (45 patients) randomized to receive cups with or without augmentation. As part of the 14-year follow-up with conventional radiographs of the pelvis, two pairs of stereo radiographs and a CT scan were obtained. Migration and wear were measured by RSA. The volume and type of osteolysis were determined on CT. Furthermore, we calculated the precision and limit of agreement of RSA and CT to compare these two modalities as tools for migration measurements.

In study IV, we compared the risk of cup revision between 10,371 uncemented cups with and 12,354 without screw holes, using data from the Swedish Hip Arthroplasty Register.

Results:

Study I: Cup stability was equally good regardless of cup augmentation. The mean wear rate of the cup liner was high, at 0.21 mm/year, with no significant difference between the groups.

Study II: The limit of agreement between CT and RSA was 1.15°, 1.51°, and 0.70° for rotation and 0.46, 0.43, and 0.52 mm for translation. These results were within the described normal 99% confidence limits for precision in RSA: 0.3° to 2° for rotation and 0.15 to 0.6 mm for translation.

Study III: Osteolysis of some degree was visible in all 48 hips on CT. We found three different types of osteolytic lesions: type 1A, absent trabecular bone and a sclerotic border around the lesion; type 1B, absent trabecular bone and no sclerotic border; and type 2, reduced radiodensity and reduced trabecular number. Cups with screw holes were surrounded with larger osteolytic lesions, and osteolysis around these cups was more likely to be a type 1A lesion.

Study IV: Cups without screw holes showed a decreased risk of cup revision (implant exchange or removal) due to any reason at both 2 years (adjusted hazard ratio, HR: 0.6, confidence interval, CI: 0.5-0.8) and 10 years (HR: 0.7, CI: 0.5-0.9). However, for aseptic loosening, there was no significant difference between cups with and without screw holes, with an implant survival rate of 99.9% (CI: 99.8-99.9) at 2 years and 99.1% (CI: 98.6-99.7) at 10 years.

Conclusion: Uncemented cups augmented with screws, pegs, or hydroxyapatite do not have improved long-term stability compared with cups press-fit only. Unsealed screw holes in uncemented cups appear to be a risk factor for the development of larger osteolytic lesions. CT showed three different types of osteolytic lesions. The risk of aseptic loosening for modern uncemented cup designs is very low, and cups without additional augmentation do not have an increased revision rate. In contrast, the risk of cup revision for any reason was higher for cups with screw holes. CT can be used for migration studies for the longitudinal evaluation of patients with tantalum markers with precision comparable to that of RSA.