Introduction: Metal-on-metal resurfacing has been recommended as a promising option for the treatment of degenerative hip disease in young, active patients. However, early failure rates have remained higher compared to conventional primary hip arthroplasty. Nevertheless, in the UK, in 2006 more than 43% of patients under the age of 55 years requiring primary hip replacement underwent a resurfacing procedure. This in fact exemplifies the urgent need to assess failure mechanisms to improve overall results and durability. Different failure modes have been considered, however data on cementing and histological changes beneath the cap are rare. Thus, the intention of this study was to examine bony architecture and cementing features, as it has been hypothesized that cementing might have major impacts on failure mechanisms.

Methods: In an international study we analyzed a total of 118 femoral components retrieved at revision surgery of patients with failed hip resurfacing arthroplasties. The specimens were dissected by means of a diamond coated saw, leaving the implant-bone composite as well as the cement interface intact. The specimens were subsequently processed to 300µm block grindings using the technique first described by Donath. The grindings in addition to the undecalcified preparation enabled the analysis of cement penetration at the dome of the cap (zone 1), the intermediate (zone 2), as well as the radial region (zone 3) respectively. Furthermore undecalcified 5µm sections were cut for histomorphometry analysis according to ASBMR standards and analyzed by quantitative Backscattered Electron Imaging. Osteoid Surface (OS/BS, %) and Osteoid Volume (OV/BV, %) were determined right at the cement-bone interface. Statistical analyses were performed using SPSS 15.0 for Windows (SPSS Inc., Chicago, IL, USA) software.

Results: 12 out of 118 cases analyzed showed obvious characteristics of demineralization suggesting a mineralization defect of trabecular bone right at the interface. The latter was found in resurfacing cases that endured significantly longer in vivo compared to failures without demineralization (p=0.041). Comparing the results of all 118 cases mainly female patients were affected (p=0.027) as they also showed a constantly larger cement penetration throughout all three regions of interest (Fig.1). This was confirmed by increased OV/BV and OS/BS values in cases found with demineralization. Backscatter analysis revealed that the loss of bone mineral due to the indicated mineralization defect is not limited to the surface of the interface bone trabeculae but also manifests itself in the mineralized bone where the mineral content was decreased (6.6%) (Fig.2).

Discussion: Analysis of the bony architecture beneath the resurfacing component revealed the loss of bone minerals. In fact, demineralization of the bones occurred upon the permanent exposition to the cement. A gender comparison elucidated that female patients showed significantly higher cement penetration and in its consequence in those cases larger mineralization defects were found.

This study has two primary limitations: First, the group of cases showing long term changes is relatively small. Subsequent studies will allow to analyze more cases after long term failure. Second, due to the international design of this study, resurfacing procedures were performed by different surgeons. Furthermore five different resurfacing devices were included, which we did not differentiate as they share common design features in regards to cementation. In spite of these limitations we are not aware of a similar study analyzing cement effects on femoral bone tissue after failed resurfacing arthroplasty previously.

In conclusion this study reveals significant changes at the cement bone interface including demineralization being associated with gender, time of implantation and cement penetration that are potentially of paramount clinical importance in regard to long term success of hip resurfacing arthroplasty.


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