A novel test method for evaluation of the abrasive wear behaviour of total hip stems at the interface between implant surface and bone cement.

After total hip replacement, some cemented titanium stems show above-average early loosening rates. Increased release of wear particles and resulting reaction of the peri-prosthetic tissue were considered responsible. The objective was to develop a test method for analysing the abrasive wear behaviour of cemented stems and for generating wear particles at the interface with the bone cement. By means of the novel test device, cemented hip stems with different designs, surface topographies and material compositions using various bone cements could be investigated. Before testing, the cemented stems were disconnected from the cement mantle to simulate the situation of stem loosening (debonding). Subsequently, constant radial contact pressures were applied on to the stem surface by a force-controlled hydraulic cylinder. Oscillating micromotions of the stem (+/- 250 microm; 3 x 10^6 cycles; 5 Hz) were carried out at the cement interface initiating the wear process. The usability of the method was demonstrated by testing geometrically identical Ti-6Al-7Nb and Co-28Cr-6Mo hip stems (n=12) with definite rough and smooth surfaces, combined with commercially available bone cement containing zirconium oxide particles. Under identical frictional conditions with the rough shot-blasted stems, clearly more wear particles were generated than with the smooth stems, whereas the material
composition of the hip stems had less impact on the wear behaviour.