

Publication	Corrosion in Modular Revision Hip Stem Tapers – A Retrieval Analysis. Bormann T, Yan H, Jaeger S, Schonhoff M, Kretzer JP. Orthop Res. 2025. doi: 10.1002/jor.70078. https://pubmed.ncbi.nlm.nih.gov/41039646/ (online access)
Study	Retrieval study
Implants	Modular revision stems: Prevision (B. Braun Melsungen AG), Revitan/PFM-R (Zimmer Biomet), MRP-TITAN (PETER BREHM GmbH), Restoration Modular System (Stryker), Reclaim (DePuy Synthes)
Retrievals	64
Follow-up	-
Methods	Corrosion and fretting were investigated at the junction between stem and neck piece, as well as implant and patient specific parameters for different modular revision stems. The retrieval register of the Department of Orthopaedics at the Heidelberg University Hospital (Germany) was used for this purpose. Inclusion criteria were: retrievals removed between 2014 and 2022; patient consent to destructive testing of the retrievals, and an implant design with a taper connection between stem and neck piece. 64 retrievals met the criteria. Exclusion criteria were: fractured modular stems (n=4), taper diameter >16 mm (n=1) and more than one taper connection (n=4). In 23 cases, the retrievals had assembled taper connections. In 2 cases, the components could not be disassembled. A total of 53 retrievals remained for investigations. Corrosion and fretting were determined using a modified Goldberg score. The contamination of the taper connection was assessed using a similar rating system. If the stems were still joint to the neck piece, the push-out force required to separate the parts was measured as an indicator for connection strength. A multivariate multiple linear regression analysis was accomplished to determine whether specific parameters lead to corrosion at the taper junction.
Results	The regression analysis showed that corrosion and fretting are significantly affected by implantation time, implant system, body weight and taper contamination. Signs of corrosion and/or fretting were detected in almost all investigated taper connections. Severe corrosion was found in 19% of

	cases. Significant fretting was observed in 26% of cases. Taper contamination was detected in 42 of 53 cases. Severe contamination was observed in 14 cases (26%), mild contamination in 15 cases (28%) and moderate contamination in 4 cases (8%). Manufacturers can influence the occurrence of fretting through specific design parameters (e.g. cone geometry, material, surface roughness). It was found that the Revitan/PFM-R stem examined differs significantly from the other designs of the modular interface. Revitan/PFM-R stems showed higher fretting scores than MRP-TITAN stems and Prevision stems. The engagement length of the taper connection of the Revitan/PFM-R stems is approximately half the length of the taper connections of most of the other stems investigated. This may lead to an altered response to micromotion upon taper loading. The stem taper has a machined surface, which may be more susceptible to fretting than rougher peened surfaces. In addition, the Revitan/PFM-R taper connection combines two different metals in the modular interface (stem made of CoCr, neck piece made of a titanium alloy), which can lead to increased fretting-corrosion. In all other examined retrievals, the taper connection was made from titanium alloy only.
Key Points	The retrieval study confirms the relation between contamination of the taper surface and taper corrosion. Contaminants can increase micromotion at the interface of taper connections. This damages the passive layer of the alloys, facilitating corrosive processes. Residuals from contamination (e.g. bone particles) can damage the passive layer at the interface or lead to chemical alterations within the interface. The study underlines the importance of clean taper surfaces prior to joining the components, which is essential for the long-term stability of the modular implant. Contaminations can significantly reduce the connection strength of taper connection and lead to increased corrosion. If modular revision stems are used, care should always be taken to ensure that the taper surfaces are clean before connecting the stem and neck piece. Intraoperative contamination can lead to reduced connection strength or an increase in micromotions and associated corrosion processes, even after the implant has been in use for several years. The authors emphasise that manufacturers should offer tools that enable cleaning of taper surfaces. PETER BREHM is the only manufacturer on the market that provides surgeons with the TAPER WIPER, an instrument for standardised cleaning of the modular interface.
Abbreviations	CoCr – Cobalt Chromium