

How to reduce fretting corrosion

Avoid using ball heads with high lateral offset; retain macroscopically undamaged stems at revision; pay particular attention to the progression of fretting corrosion as well as to the special risks associated with heavy and active patients. **Wight et al.** give these recommendations on how to mitigate fretting corrosion on the basis of a systematic literature review including 91 articles.

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Sleeves well tolerated

Patients with large-diameter sleeved ceramic ball heads have elevated titanium levels in the blood, but this has no clinical consequence. **Deny et al.** compared whole blood Ti levels at minimum 1-year follow-up in patients who had received sleeved 44–48mm heads and patients who had received 36–40mm heads without sleeves. There were no signs of adverse reactions to metal debris (ARMD) in either group, and the clinical results were similar.

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Second PJI Consensus Meeting

The Second International Consensus Meeting on Prosthetic Joint Infection (ICM) will be held in Philadelphia (USA) on July 25–27, 2018. The steering committee of Javad Parvizi and Thorsten Gehrke has brought together a faculty of over 800 renowned experts in the field who agreed to serve in the convention. Its aim is to develop a consensus document outlining treatment options for infection patients.

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Published by CeramTec GmbH
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Sleeved heads recommended for revision

The use of ceramic ball heads with titanium alloy sleeves helps to reduce the risk of adverse local tissue reactions (ALTR) without compromising the ceramic head's strength and the corrosion resistance of the modular junction. **Koch et al.** came to this conclusion after analyzing 24 retrieved hip implants with BIOLOX®OPTION sleeved ceramic ball heads. The sleeve allows using a ceramic head on the used taper of a stem remaining in situ at revision that, without sleeves, could exert an inappropriate load on the female taper.

The ball head's inner taper was graded by a metal transfer scoring system. Fretting and corrosion of the titanium sleeves' inner and outer surfaces were evaluated by the Goldberg scale. The retrieved components showed little mechanical or corrosive damage. The mean fretting score was 1.8 for the inner and 1.2 for the outer sleeve surface. The mean corrosion score was 1.8 for the inner sleeve; no corrosion was observed on the outer surface. The magnitude of fretting corrosion was not correlated to stem material.

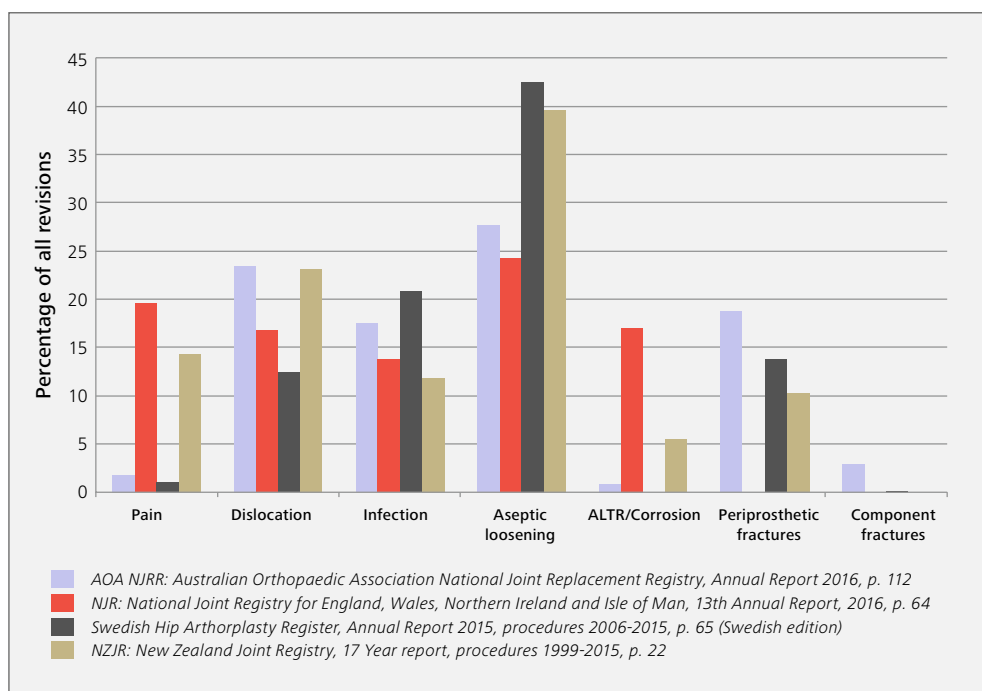
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AAHKS 2017 update on fretting corrosion

At the 2017 Annual Meeting of the American Association of Hip and Knee Surgeons, **Berry** moderated a symposium dedicated to "The 'New Disease': Taper Corrosion". Metal levels are the cornerstone of diagnosis: with a well-functioning MoP bearing, they should be lower than 1ppb in the blood/serum, said **Della Valle**. He recommended to make sure that the taper is dry and that a metal head is impacted ("hit hard") with enough force for preventing fretting corrosion. **Jacobs** noted that existing data show a variation in prevalence by year of surgery between 0% and 10.5%. The implant-related factors are head size, taper geometry, taper tolerances, surface finish, flexural rigidity, material composition, metallurgy and multiple metal-metal contacts. He put up the question if cobalt alloy heads and stems should not be abandoned altogether. **Bolognesi** found sleeved ceramic ball heads for revision probably the best available option, pointing out that the majority of high-volume revision surgeons uses them. He urged to cleanse the taper with great effort and care. **Mabry** gave these recommendations for prevention: revise any component malposition, maximize femoral-head diameter, consider using dual mobility bearings, and lower the threshold for constrained liners.

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Reasons for revision in THA



Executive Summary

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Title	Ceramic bearings with titanium adapter sleeves implanted during revision hip arthroplasty show minimal fretting or corrosion: a retrieval analysis
Authors	Koch C. N., Figgie M. Jr, Figgie M. P., Elpers M. E., Wright T. M.
Journal	HSS Journal (2017) 13: 241. https://doi.org/10.1007/s11420-017-9566-4
Level of Evidence	Not indicated
Summary	<p>Koch et al. aimed with this retrieval study to evaluate the magnitude of fretting, corrosion and metal transfer with sleeved ceramic heads. The titanium alloy sleeve allows the use of ceramic heads on used stem tapers that otherwise could be subjected to an inappropriate load on female taper. However, the sleeve creates new metal-ceramic and metal-metal interfaces, which may be prone to corrode.</p> <p>24 hips with BIOLOX®<i>delta</i> heads and a paired with the titanium sleeve (BIOLOX®<i>OPTION</i>) were revised from December 2011 to December 2015 in 14 primaries and 10 revision hip replacement surgeries at the Hospital of Special Surgery (New York, USA). The reason of the revisions was not related to trunnion complications and none of the revisions were related to the femoral head. The mean implantation time was 15.5 months (range 1 -65), the mean patient age was 61.1 years (range 33-81) and average BMI was 28.3 (range 20-63), 13 were males and 11 females. 15 femoral stems were from titanium alloy, 6 from CoCr and 3 from TMZF. The ceramic heads bearing and taper surfaces were graded by metal transfer scoring system. The fretting and corrosion of titanium sleeves' inner and outer surfaces were evaluated by Goldberg's score.</p> <p>The mean fretting score was 1.8 for the inner sleeve surface and 1.2 for the outer. The magnitude of fretting corrosion was not correlated to stem material. The mean metal transfer score of 2.3 was similar to the findings of a previous retrieval study performed by the authors with BIOLOX®<i>forte</i> heads.</p> <p>In summary, the retrieved components showed little mechanical or corrosive damage. The authors' findings support the use of BIOLOX®<i>OPTION</i> heads. The ceramic heads with the titanium sleeve are a safe option in revision total hip replacement.</p>
Study Limitations	<p>These results do not necessarily represent taper junction settings in well-functioning THAs.</p> <p>The sample size is small with short length of implantation (15.5 months).</p>
Key Messages	<p>The total Goldberg's score of inner sleeve surface was found significantly ($p < 0.05$) higher than the outer surface, but the magnitude of corrosion is low and the damage minimal.</p> <p>BIOLOX®<i>OPTION</i> is a safe alternative to reduce the ALTR risk without compromising the ceramic head strength and the corrosion resistance of modular junction.</p>

CONGRESS REPORT

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AAHKS Symposium Fretting Corrosion 2 - 5 November 2017 Dallas (TX) USA

Daniel J. Berry, MD, (Mayo Clinic Rochester (MN)) moderated a symposium on “**The ‘New Disease’: Taper Corrosion**” at the 2017 Annual Meeting of the American Association of Hip and Knee Surgeons. Its aim was to define the state of the art in dealing with this emerging problem, from diagnosis to treatment and prevention. The take-home messages are summarized below.

Diagnosis

In his talk, **Craig Della Valle, MD** (Rush University Medical Center Chicago (IL)) explained that the symptoms of fretting corrosion might be similar to PJI, but the problems associated with taper corrosion typically appear with pain, the implant is revised at a mean of 4.3 years. According to **Della Valle**, metal levels are the “cornerstone” of diagnosis: with a well-functioning MoP bearing, they should be lower than 1 ppb in the serum. However, the cobalt level are generally above 1 ppb after revision arthroplasty. Findings should be confirmed with cross-sectional imaging for ALTR. Infection has to be ruled out, but beware: in cases of fretting corrosion, purulence can be seen, the synovial fluid WBC count can be falsely elevated, and even the Alpha defensin value can be false positive. For prevention of fretting corrosion, **Della Valle** recommended to make sure that the taper is dry and that a metal head is impacted (“hit hard”) with enough force.

New data on corrosion

Joshua Jacobs, MD (Rush University Medical Center Chicago (IL)) raised the question of the prevalence of fretting corrosion, trying to understand why we have seen more and more taper corrosion in the past five years. There may be a perception bias as concerns had already been raised in the 1980s and 1990s without causing much awareness of the problem. Nevertheless, **Jacobs** pointed out that existing data show a variation in prevalence by year of surgery between 0 % and 10.5 %. The implant-related factors are head size, taper geometry, taper tolerances, surface finish, flexural rigidity, material composition, metallurgy and multiple metal/metal contacts. According to **Jacobs**, there is a wide variation in the flexural rigidity of different taper designs. Overdiagnosis must be taken into account as there is a discrepancy between the prevalence of head-neck corrosion in retrieval studies and the cases of clinically relevant ALTR. In case of fretting corrosion, the cobalt levels in the serum are more elevated than the chromium levels. Reports of ALTR are always associated with modular junctions involving a CoCr alloy component. For prevention, **Jacobs** suggested to minimize the micromotion of modular junctions (tolerances), control the lever arm (head size, neck length), optimize surface finish, geometry (flexural rigidity), intraoperative assembly, tribocorrosion resistance of the alloy and material selection. He put up the question if cobalt alloy heads and stems should not be abandoned altogether.

Revision

Are ceramic heads and titanium sleeves always the best solution? **Michael P. Bolognesi, MD** (Duke University Medical Center Durham (NC)) found it hard to argue against this solution for the revision setting. The necessary preconditions are that the trunnion looks good and that using a metal head still could be considered. He pointed out that the majority of surgeons doing high numbers of revisions predominantly uses sleeved ceramic heads, which is probably the best available option. The speaker could not name a safest way to clean a used taper but pointed out that cleaning devices are available. He urged to cleanse with great effort and care. Several factors must be taken into account at the decision between retaining and exchanging cup and stem, e.g. quality of trunnion surface, stem design and fixation, state of the abductor, head size in place, cup position. There is not much data on soft tissue debridement, its extent remains subject to the surgeon’s intraoperative decision.

Prevention

Tad M. Mabry, MD (Mayo Clinic Rochester (MN)) dedicated his talk to the prevention. Quoting **McGrory** and **Matharu**, he identified as the enemy the “Five I’s of complication”: infection, instability, implant loosening, ions and impairment. After THA revision for ALTR, there is an elevated risk of PJI, which is hard to distinguish from ALTR. In order to maximize stability, **Mabry** gave these recommendations: revise any component malposition, maximize femoral-head diameter, consider using dual mobility bearings, and lower the threshold for constrained liners. Implant loosening compromises the local bone stock and may be due to failed intra-operative recognition. When metal ions are detected in case of recurrent ALTR: remove CoCr implants, use heads made of ceramic or ceramicized metal. With the option of using titanium sleeves, the removal of well-fixed and well-positioned implants is rarely indicated. **Mabry’s** advice: Be aware of diagnosis, look for any symptomatic patient; the earlier the revision, the fewer the complications.

Executive Summary

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Title	Evidence based recommendations for reducing head-neck taper connection fretting corrosion in hip replacement prostheses
Authors	Wight C. M., Lanting B., Schemitsch E. H.
Journal	Hip Int. 2017 Nov 21;27(6):523-531. doi: 10.5301/hipint.5000545.
Level of Evidence	Not indicated
Summary	The authors performed a systematic literature review with the aim to collect all the available knowledge about fretting corrosion occurrence in hip arthroplasty, in order to offer recommendations to reduce its incidence. "Taper", "trunnion", "cone", "head-neck junction", "hip" were the terms used for the search algorithm in Pubmed, MEDLINE and EMBASE. The inclusion criteria were total hip replacement, full text available, publication in English, investigates prosthesis design/implant manufacture and/or surgical factors and investigates fretting corrosion and/or material loss. Patient metal ions levels and Adverse Reactions to Metal Debris (ARMD) were the outcome measures of clinical studies. The qualitative and semi-quantitative visual assessment, wear volume and surface profile were the outcome measured for retrieval studies. These were the same for the in-vitro studies with the addition of the electrochemical activity.
	The initial search resulted in 1,224 articles, but 91 remained for the analysis. Avoid use of high lateral off-set femoral heads, retaining macroscopically undamaged stems at revision, paying particular attention to fretting corrosion's progression with time and risk with heavy or more active patients resulted to be the general recommendations to mitigate fretting corrosion.
	Small head sizes, avoiding cast alloy femoral heads and avoiding stem with low flexural rigidity are recommended for the use of metal heads.
Study Limitations	Publication bias.
	Only publications in English searched.
Key Messages	Fretting corrosion is a multifactorial problem.
	Prostheses selection is critical and has to be carefully considered.
	Use of ceramic head as an alternative to metal is strongly supported, in order to mitigate the occurrence of fretting corrosion.
	According to the authors, there is fair evidence to prefer the use of ceramic or ceramicised metal heads rather than metal heads to mitigate the risk fretting corrosion.