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# **AAOS** Diagnosis and Evaluation

## **Trunnion Corrosion in Total Hip Arthroplasty: Diagnosis, Evaluation, and Management**

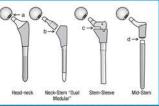
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Sponsors: Biomedical Engineering Committee

# **Incidence**

National joint registries have served a critical role in identifying early failures and increased revision rates associated with an implant Increased revision rates with dual taper stems have been observed with large national registries.

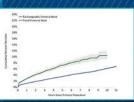
#### Types of Modularity



There are many different types of modularity. Headneck and stem-sleeve junctions have been used for an extended period of time. Adverse local tissue initially appreciated in MoM THA, Lessons learned from the MoM

experience allowed an appreciation for the diagnosis occurring at the neck-stem junction and later at the head-neck junction.

#### **Increased Revision Rates Associated with Dual Modular Taper**

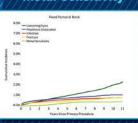


Increased revision rates with dual taper stems have been observed with large national registries.

Australian Registry 2013

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#### **Revision Associated with Metal Sensitivity**



The Australian Registry has also observed a small but measurable revision rate for metal sensitivity that is associated with head-neck taper corrosion.

Australian Registry 2013

## **Evaluation**

The initial evaluation and diagnosis of ALTR secondary to taper corrosion is based on history, physical exam, imaging, and laboratory workup. The evaluation of ALTR in taper corrosion is largely based on the evaluation of ALTR for MoM.

#### Serum Metal Ion Levels

Serum metal ion level measurements are a well established tool in the diagnosis of ALTR. An important principle is that serum metal ion levels should not be used to make a diagnosis of ALTR alone. There are a series of important points with using serum metal ion levels in the diagnosis of ALTR

- Stringent adherence to sample collection important.
- There is no defined threshold value to make the diagnosis of ALTR.
- Cutoff dependent on type of corrosion. Dual taper corrosion has a suggested lower threshold than MoM.

#### Metal Ion Threshold: MoM

- British Medicines and Healthcare products Regulatory Agency: Co or Cr above 7ppb (MHRA; 2010)
- Using MHRA cutoff of 7ppb, 89% specificity and 52% sensitivity for detecting failed MoM. A more optimum cutoff was found at 4.97 ppb with a 63% sensitivity and 86% specificity. (Hart JBJS Br 2011)
- Again despite which threshold is selected, sensitivities (true positive rate) at 50 or 60% stresses the importance of the inability of serume metal ions levels to make the diagnosis of ALTR alone.

Cut-off (ppb)	Sensitivity (95% CI)	Specificity (95% CI)
4.83	63% (51 to 72)	85% (76 to 92)
7.20	52% (41 to 63)	91% (82 to 96)
9.58	44% (34 to 55)	95% (88 to 99)

Hart 2011 Note: ppb = Tug/L = Ing/mL

### Metal Ion Threshold: Dual Taper

 Vundelinckx J0A 2013 (n=19)
 Jacobs JBJS 2013 (n=11) Co: 50% patients >4 ppb; Co: mean 7 ppb

Cr. mean 0.6 nob

Cr: All patients below 1.3 ppb (n=19)

Overall, serum metal ion levels appear to be elevated in dual modular taner similar to MoM

Note: ppb = fug/L = Ing/mL

#### Metal Ion Threshold: MoP THA

There are limited clinical reports of serum metal ion levels in MACC at the head neck taper interface of metal on polyethylene bearing surfaces. The largest series to date was a retrospective review of

Mean o Std. Dev. Range Ranger \*All values are given in ng/IniL. I Reference data are from pa at our institution with a well-functioning metal on polysthylen

#### Metal Ion Threshold: Co/Cr ratio

Multiple studies have demonstrated elevated Cobalt/ Chromium ratios (Co/Cr) in failed dual taper modular stems and MACC. Vundelinckx (2013), Jacobs (2013) and Gill (2011) all reported substantially higher cobalt levels than Cr. As such, AHHKS/Hip Society and AAOS guidelines suggest a Co/Cr ration > 5 as a risk factor for MACC (Kwon 2013)

The mechanism behind elevated CO/Cr ration is poorly understood. As compared with MoM failure which is a result of bearing surface wear. dual modular taper is a result of MACC, a corrosion process. The Cobalt is more soluble dissipating as free ions where the chromium precipitates as a chromium orthophosphate (Kretzer 2009; Gill 2012). Other possibilities include that Cr is added to Co alloys given its resistance to corrosion. In MACC, if rates of Co corrosion are higher, free Co levels

#### **Imaging: Different Modalities**

Multiple imaging modalities exist to assess the possibility of adverse local tissue reaction from corrosion. The body of work is heavily based on initial experience with MoM THA.

- Radiographs: Gold standard for initial evaluation.
- Ultrasound: Low-cost alternative to visualize fluid collections when an MRI is contraindicated (ie pacemaker).
- CT: Provides accurate assessment of component alignment
- MRI: Imaging modality of choice in assessing

#### MARS MRI Grading Systems





Type 1 reactive masses Coronal and transverse STIR images from a thin walled cystic Type 1 lesion (arrow)





Type II reactive masses Coronal STIR and transverse T2 images showing thick walled cyst (arrow)





Type III reactive masses Coronal and transverse STIR images show heterogenous solid mass (arrow)

# **Treatment**

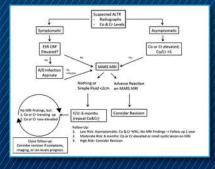
#### Risk Stratification: Dual Modular Taper: Moderate Risk

	Dual Taper Moderate Risk	
Symptoms	Symptomatic	
Clinical Exam	Limp	
Implant Type	Dual taper stem(modular neck and body)	
Radiographs	No osteolysis	
Metal ion levels	Moderate elevation (1-5ppb)	
Co/Cr ratio	1-5	
Cross-sectional imaging	Abnormal tissue reaction (no muscle bone involvement) Simple cystic lesions small cystic lesions without thickened walls	
Treatment	Followup 6 months Consider revision if symptoms, imaging, metal ions progres	

#### Risk Stratification: **Dual Modular Taper: High Risk**

Dual Taper High Risk	
Symptomatic	
Limp, Abductor weakness, swelling	
Dual taper stem(modular neck and body)	
Medial calcar or trochanteric erosion	
High>5	
>5	
Abnormal tissue with muscle & bone involvment Mixed or Solid lesions Lesions with thickened walls	
Consider revision surgery	

## **Treatment Algorithm Taper Corrosion**



Magee Bone and Joint Center Taper Corrosion Algorithm based on AAOS dual taper and MoM risk stratification algorithm.

Patients in a low risk group should have continued regular annual follow up examination. Moderate risk patients should have a more close follow up at every 6 months. High risk patients should consider revision surgery or be followed on a close basis,