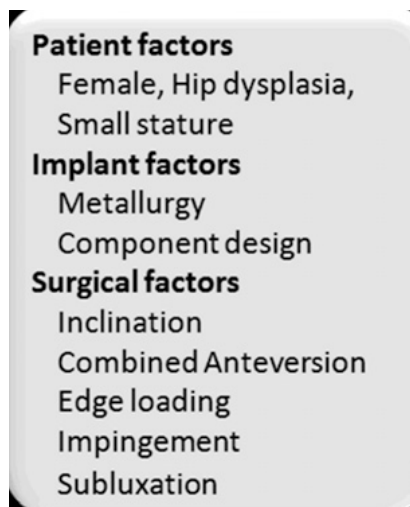


# PSEUDOTUMORS

Vasu Pai

**ARMD Adverse reaction to metal debris.** Langton identified that there is no clear consensus in the literature defining the boundaries of the terms “metallosis”, “aseptic lymphocyte-dominated vasculitis-associated lesions” (ALVAL), and “pseudotumors” and used the term **adverse reactions to metal debris**

## FACTORS



**The duration of follow-up did not prove to be a predictor.** In some developed between 1.5 and two years postoperatively, **suggesting patient susceptibility is an important etiological factor.** In revision surgery, 98 pseudotumors were found in 167 ASR MoM hips (59%).

Some studies have suggested that edge-loading, resulting from adverse cup orientation, leads to more wear. In a recent study it was shown a rate of pseudotumor formation in hips with well-positioned metal-on-metal hip replacements to be similar to that in hips with replacements positioned outside the safe zone. Inclination angle did not prove to be a predictor in a recent study.

## PATHOGENESIS

Metal-on-metal articulations generate approximately  $6.7 \cdot 10^{12}$  to  $2.5 \cdot 10^{14}$  particles

every year, which is 13,500 times the number of polyethylene particles produced from a typical metal-on-polyethylene bearing.

**a. Polywear and pseudotumor**

Polyethylene debris is taken up by macrophage giant cells that release prostaglandin E<sub>2</sub>, which resorbs bone, causing the implant to loosen and leading to a vicious cycle of wear and loosening. Usually represent a nonspecific foreign-body reaction.

**b. Metallosis and pseudotumor**

Willert et al. revealed an active cellular reaction with diffuse and perivascular infiltrates of lymphocytes and plasma cells, increased endothelial venules, fibrin exudation, accumulation of macrophages with drop-like inclusions, and infiltrates of eosinophilic granulocytes and necrosis. These histological findings were described as ALVAL [hypersensitivity reaction]

Incidence: It was thought to be 1% symptomatic pseudotumor and 5% asymptomatic pseudotumor with surface replacement [high in modular due to increase trunion corrosion as in ASR]. Recent report [JBJS 95-A,17:1560] indicates the prevalence of pseudotumors was high (28%). Most of the pseudotumors (72%) were asymptomatic. Recently Williams et al. found a 25% prevalence of pseudotumors detected by ultrasound in twenty asymptomatic hips after a resurfacing arthroplasty

**Modes of failure metal on metal [Orthop Clin N Am 46 (2015) 185–192]**

**1. Biological mechanism:**

ALTRs [associated lesion tissue reactions] caused by the inflammatory response to metal debris. These local responses can result in tissue necrosis and adverse soft tissue reactions. It is likely a type IV hypersensitivity response initiating T lymphocytes and macrophages to create a cytotoxic inflammatory response [originally described as ALVAL]

**2. Corrosion in Hip arthroplasty at Trunion:** Newly described complication of modularity of Hip joint. It occurs at head neck junction. It gives rise to ALTR. Mechanically assisted crevice corrosion between two metallic surfaces can wear away the protective oxide layers on the metal surfaces. Once the

oxide layer is compromised, corrosion at the junction can occur through a complex chemical reaction. Taper corrosion is often treated with head ball exchange with placement of a ceramic head ball with a titanium sleeve.

3. **Cup malalignment:** A high abduction angle leads to diminished bearing lubrication leading to increased ion release and soft tissue reactions. A relatively horizontal cup position may increase lubrication leading to improved wear characteristics. Unfortunately, may account for edge loading.

## CLINICAL FEATURES

1. Painful THR with or without click
2. Pain is usually in the groin or trochanteric region
3. Pressure effects on vital structures in the vicinity, including veins, nerves, and ureters.
4. Suboptimal component positioning

The recent focus on pseudotumors associated with metal-on-metal bearings indicates that pseudotumors are associated not only with a soft-tissue mass and osseous changes of osteolysis and erosions but also with damage to the periarticular soft tissue. The damage may lead to soft-tissue and muscle necrosis, osseous denudation, pathological fractures, and hip dislocations. The problem of hypersensitivity to metal in patients with metal-on-metal bearings has been suspected, investigated, and debated for over thirty years.

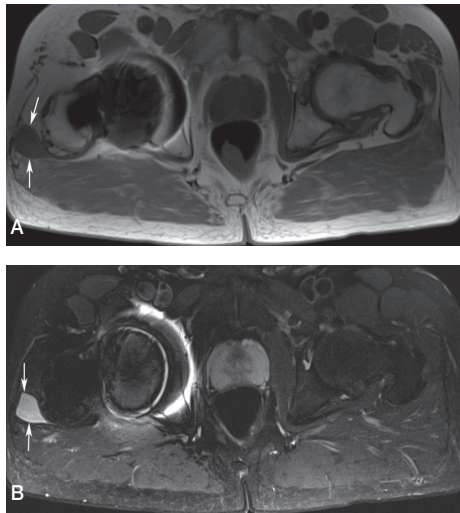
## INVESTIGATIONS

1. **Suspect:** when there is groin and hip pain. **Urine and Serum for Chromium and Cobalt** Whole-blood metal ion levels were slightly elevated (cobalt 7.5 ppb and chromium 5.8 ppb; [normal reference values are < 0.8 ppb for Co and Cr])
2. **Radiographs** to exclude aseptic implant loosening, femoral neck stress fracture or collapse of the femoral head, and femoroacetabular impingement. Identify prosthesis: ASR more than Birmingham
3. **Alignment:** more with malaligned [due to edge loading] more with excessive cup inclination or anteversion.

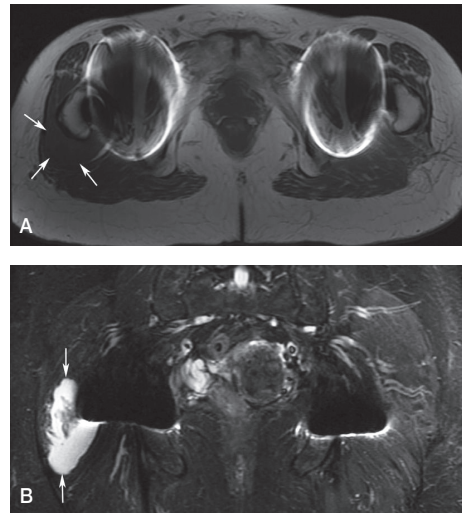
4. **Multi-slice computed tomography** scanning is necessary to assess femoral neck anteversion.

### 5. MRI Types of Pseudotumors

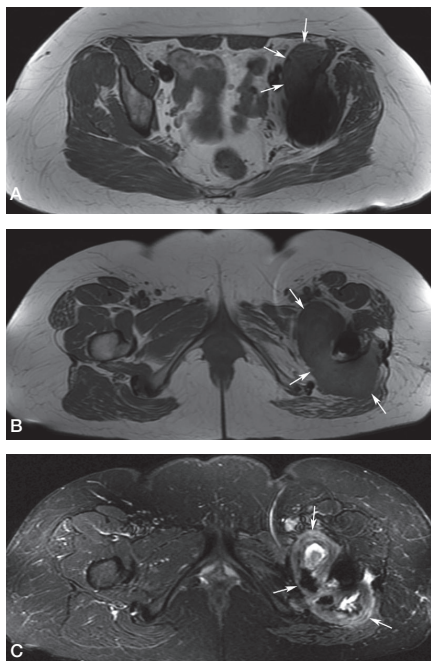
#### I Thinned wall cyst



#### II Thick walled cyst



#### III Predominantly solid swelling extending to iliopsoas area



7. **Hematologic testing** and microbiological assessment of joint aspirate is needed to

rule out infection.

8. **Positive bone scan** studies can indicate infection/loosening.

9. In the past, **skin patch** testing was used. The value of patch testing is limited

10. **Biopsy** and tissue analysis allows an appropriate diagnosis of these reactions.

### **Biopsy ARMD**

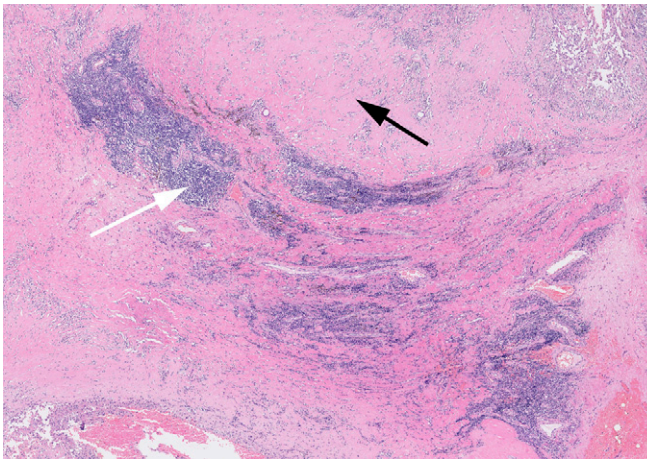


Fig. 3  
Low-power photomicrographic image of ARMD (adverse reactions to metal debris), demonstrating the dense, deep eosinophilic (pink) fibrinoid material lining the pseudocyst (upper and lower area), with the thick dense (blue) lymphoid aggregates, composed of lymphocytes and plasma cells, between the fibrinoid material. The white arrow indicates lymphocytic aggregates, and the black arrow indicates fibrinoid necrosis and tissue organization (hematoxylin and eosin stain, original magnification,  $\times 25$ ).

The clinician cannot rely solely on a single variable to determine the need for intervention, multiple variables must be considered.

### **TREATMENT**

#### **Follow up Guidelines: Varies**

##### **1. Pseudotumors in patients with metal-on- polyethylene implants**

A cementless revision prosthesis combined with cancellous bone-grafting. Logical to use: ceramic or ceramic; or poly Vs metal

##### **2. Metal-on-metal bearing hip replacement fails from a pseudotumor**

There is growing support for an early revision to a non- metal-on-metal bearing hip arthroplasty

3. **Trunnionosis:** If trunnionosis is encountered at the time of revision surgery, the trunnion should be cleaned carefully. If severe corrosion is not present, stem retention is usually preferred because of the morbidity encountered with removal of well-fixed cementless stem. Revision consists of eliminating as much of the cobalt from the system as possible, thereby revising the head to a ceramic head with a titanium sleeve. As with MoM bearing revisions, there should be a drop in the cobalt and chromium ion levels after revision

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Follow-Up Guidance for Large-Diameter Metal-on-Metal Hip Arthroplasty Patients Published by Worldwide Authorities.

	MHRA UK [16]	EFORT Europe [17]	FDA USA [18]	TGA Australia [19]	Health Canada [20]
Distinguishes between HR and large-diameter THA	Yes	Yes	No	Yes	No
Follow-up protocol	All THA ≥36 mm + symptomatic HR – annually for implant life Asymptomatic HR <sup>a</sup> – as per local protocol	All THA ≥36 mm and HR with risk factors <sup>d</sup> – annually for implant life All HR without risk factors – annually for first 5 years (then as per local protocol)	All MoM hips <sup>c</sup> Asymptomatic = every 1 to 2 years Symptomatic = at least every 6 months	All MoM hips with symptoms, & asymptomatic THA ≥36 mm or HR ≤ 45 mm – at least annually Other MoM hips with no symptoms – as per practice for non-MoM hips All MoM hips = x-ray + ions + imaging	All MoM hips with symptoms – no guidance given on regularity of follow-up All MoM hips without symptoms – annually for first 5 years (then as per local protocol) <sup>c</sup>
Follow-up for symptomatic patients	All MoM hips = ions + imaging	All MoM hips = x-ray + ions + imaging	All MoM hips = x-ray + ions + imaging	All MoM hips = x-ray + ions + imaging	All MoM hips = x-ray + ions + imaging
Follow-up for asymptomatic patients	THA = ions <sup>b</sup> HR = see above	All MoM hips = x-ray + ions Further imaging if x-ray abnormal or Co between 2 and 7 µg/l	Clinical review	Asymptomatic THA ≥36 mm or HR ≤ 45 mm = x-ray + ions + imaging Other MoM hips with no symptoms (see above)	Clinical review
Metal ion sampling	Whole blood (Co and/or Cr)	Whole blood (Co only)	Whole blood (Co and/or Cr)	Whole blood or serum (Co and Cr)	Whole blood or serum (Co and Cr)
Metal ion thresholds of concern	>7 µg/l	2-7 µg/l	None stated	None stated	>7 µg/l
Plain radiographs recommended for any patients	Not stated	All patients	Symptomatic patients only	All patients	Symptomatic patients only
Cross-sectional imaging recommended	MARS MRI or ultrasound	MARS MRI or ultrasound or CT	MARS MRI or ultrasound or CT	MARS MRI or ultrasound	MARS MRI or ultrasound
Consider need for revision surgery	If imaging abnormal and/or blood metal ion levels rising	(1) If imaging abnormal and/or blood metal ion levels raised or rising (2) If Co >20 µg/l	Decide in response to overall clinical scenario and test results, but consider early revision in patients with progressive lesions	If persistent symptoms, imaging abnormalities and/or where blood metal ions are rising	If symptoms and positive MRI (soft-tissue mass) If positive MRI (soft-tissue mass), increasing in size

Cr = chromium; Co = cobalt; CT = computed tomography; EFORT = European Federation of National Associations of Orthopaedics and Traumatology; FDA = Food and Drug Administration; HR = hip resurfacing; MHRA = Medical and Healthcare Products Regulatory Agency; MARS MRI = metal artefact reduction sequence magnetic resonance imaging; MoM = metal-on-metal; TGA = Therapeutic Goods Administration; THA = total hip arthroplasty; UK = United Kingdom; USA = United States of America.

<sup>a</sup> Excludes Articular Surface Replacement hip resurfacing.

<sup>b</sup> Imaging recommended if blood metal ion levels rising.

<sup>c</sup> Advises closer follow-up for patients at increased risk of device wear such as females, those with bilateral implants, suboptimal component alignment, or hip resurfacings with small femoral head sizes (less than or equal to 44 mm).

<sup>d</sup> Risk factors include small femoral head size (<50 mm), female gender, and low coverage arc.