International Metal-on-Metal Multi-Disciplinary Teams:

Do we manage Metal on Metal hip patients the same way?

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Abstract

There are many guidelines that guide the management of patients with MOM hips. We looked to compare the differences in management of patients with MOM hips from around the world.

Six international tertiary referral orthopaedic centres were invited to participate by organising a multi-disciplinary panel consisting of 2 or more hip surgeons and a musculoskeletal radiologist. A full clinical dataset including history, blood tests and imaging for 10 patients was sent to each unit, hence all 6 units discussed the same 10 cases. Differences in the interpretation of findings, management decision and rationale for decisions were compared using quantitative and qualitative methods.

Overall agreement between orthopaedic centres recommending treatment on the management of patients with MOM hip implants was moderate (kappa = 0.6). Full agreement was seen in a third of cases, however split decisions were also seen in a third of cases. Units differed in their interpretation of investigation findings, and put varying emphasis on serial changes in the presence of symptoms.

In conclusion, the management of raised or rising blood metal ions, cystic pseudotumours and peri-acetabular osteolysis led to inconsistent agreement between centres. Coordinated international guidance and MDT panel discussions are recommended to improve consensus in decision-making.

Introduction

Protocols are in common use to help efficiently manage patients with common problems. There are many protocols that guide the management of patients with MOM hips [1-3]. We sought peer review for our new approach [4], because these protocols are insufficient.

The early failure of metal on metal (MOM) hip implants has the potential to impact over 1 million patients worldwide. The rise in revision rates of patients with MOM hips as demonstrated by various national joint registries highlights this problem [5, 6]. Further to this, the average cost of aseptic revision is estimated at over £12,000 in the UK, putting a significant financial burden on the NHS [7]. However deciding "who", "when" and "how" revision should be performed is still an area of debate.

The UK regulatory agency (Medicines and Healthcare Products Regulatory Agency, MHRA) was the first to issue management guidelines for all MOM hips in 2010 [1]. This was followed by guidance from the FDA (Food and Drug Administration) in 2012 [8], and more recently by the European regulatory bodies (Scientific Committee on Emerging and Newly Identified Health Risks, SCENIHR) [9]. This guidance is essential to simplify decision-making. However, the advice given by each regulator varies slightly, and in some cases does not fully define how various tests are to be interpreted and therefore the recommended course of action.

The use of Multi-Disciplinary Teams (MDT) have recently been developed with the aim of using surgical experience and evidence based current best practice to reduce the uncertainty surrounding the management of patients with MOM hip implants. It is believed that MDTs improve decision-making and lead to superior

outcomes for patients [4, 10, 11], particularly since a panel of experts can pool knowledge and experience in providing a balanced viewpoint.

Our aim was to understand the degree of variability in management decisions for patients with MOM hip implants across the world. We had three objectives, (1) to recruit five orthopaedic centres of excellence across the UK, Europe and the USA, who have experience in managing MOM hip patients, (2) to compare the management decision of these units with our own when discussing the same patients, and (3) to analyse the similarities and differences in the management decisions using both quantitative and qualitative methods.

Methods

Summary

We conducted an international multi-centre comparative study to assess the similarities / differences in management of MOM hip patients with a variety of symptoms and complications. There were 3 stages to our methods, which included (1) patient selection, (2) invitation to orthopaedic centres to collaborate and, (3) analysis of outcomes using both quantitative and qualitative methods.

Patient Selection

10 patients were recruited from the base hospital, the Royal National Orthopaedic Hospital (RNOH) United Kingdom, a tertiary referral centre that employs a Multi-Disciplinary Team (MDT) to discuss patients with MOM hips [4]. The MDT team consists of four revision hip surgeons, a musculoskeletal radiologist, and a nurse coordinator, which meet on a regular basis and have discussed over 300 cases since August 2012.

Patients were selected from the database of cases discussed at the RNOH MDT. Patients were selected to demonstrate a full spectrum of clinical dilemmas. Four categories of patients were selected:

1) Metal ion dilemmas
2) Bone abnormalities
3) Soft tissue abnormalities
4) Other / Combined abnormalities

Details of the cases are summarized in table 1. Patient demographics; clinical history, examination findings and serology results were collected. Patients were only selected if sufficient clinical information required to make informed decisions

on clinical management was available. All relevant imaging, including x-ray, computed tomography, and magnetic resonance images were obtained.

Patient details and imaging were anonymised prior to sharing with collaborating orthopaedic centres. Sharing of information was conducted using secure protocols.

Recruitment of Orthopaedic Centres of Excellence

Five international orthopaedic centres of excellence were invited to participate in this study. Each centre was asked to mobilise an MDT panel similar to that used in the base hospital. Minimum requirements for the MDT panel were 2 or more hip revision surgeons, and a musculoskeletal radiologist.

The collaborating orthopaedic centres consisted of Massachusetts General Hospital (Boston, Massachusetts, USA), Hospital for Special Surgery (New York, USA), Wrightington Hospital (Wigan, UK), COXA Hospital for Joint Replacement (Tampere, Finland) and the Endoklinik (Hamburg, Germany).

Each centre was sent an identical patient pack, which included the clinical details of the patients to be discussed and the appropriate imaging for each patient. The centres were sent a structured questionnaire that asked them to comment on the patients' symptoms, implant type, serology results, imaging findings/interpretation followed by a management decision and a rationale supporting the choice of treatment for each patient.

Analysis of results

Quantitative (Statistical) Analysis

Each of the six orthopaedic centres provided a management decision for the 10 patients, therefore a total of 60 clinical decisions were available for comparison. The management decisions were categorized into either (1) Monitor, (2) Further

investigation and (3) Revision surgery. This categorization was used to aid quantitative analysis.

Inter-unit agreement (Cohen's Kappa) was run to determine if there was agreement between the six orthopaedic centres regarding management decisions. Further to this, the distribution of ratings over the six centres was compared for each of the 10 clinical scenarios using a cumulative multinomial distribution calculation. Significance was assumed if the p = value was ≤0.05. All statistical analysis was performed using SPSS version 21 statistical package (IBM, NY, USA).

Qualitative (Thematic) Analysis

All 60 clinical decisions were analysed using thematic analysis, and the concordance of themes across the 6 centres for each of the 10 patients was reported. Thematic analysis is used in qualitative research and focuses on pinpointing, examining, and recording patterns (or "themes") within data to understand certain actions, in this case decision-making [12].

The analysis was performed through the process of coding and thematisation in five phases. These phases were:

1) Reviewing of anonymised MDT transcription data (each read twice)
2) Generation of initial codes from the data
3) Searching for themes among these initial codes (focused themes)
4) Reviewing themes (frequency and concordance of themes amongst the full data set)
5) Production of the final report by applying theory to help explain the themes.

Table 2 demonstrates an example of thematic analysis as applied in this process.

This is a systematic, evidence-based method of analysis that can produce quantifiable results along with interpretive analysis.

Results

Overall agreement between orthopaedic centres recommending treatment on the management of patients with MOM hip implants was moderate. However, metal ion thresholds, including rising levels, treatment for pseudotumours and osteolysis still lead to a variation in management across the world.

Quantitative analysis

Each of the six orthopaedic units employed an MDT team to consider each patient and accordingly provided a treatment recommendation. Table 2.

Inter-unit agreement, when comparing the treatment recommendations, achieved a moderate agreement ($\kappa = 0.6$, $p = 0.21$), using the Landis and Koch criteria [13]. In-depth analysis demonstrated that 100% agreement in management decisions was achieved for only 3 patients. 5 out of 6 units recommended a similar treatment regime in 4 patients (83% agreement). However, of the remaining 3 patients, 4 out of 6 units agreed treatment (67%) in 2 patients and a split decision was seen in the final patient (33% agreement). Table 3. The distribution of treatment recommendations for each patient was assessed using cumulative multinomial distribution. The obtained distribution of ratings significantly differed from chance in all-but-one clinical scenario, where no true agreement between the units was seen (patient 7 $p>0.05$). The reasons for discordance between the orthopaedic units were further explored using thematic qualitative analysis.

Qualitative analysis

This section refers to the feedback provided by each orthopaedic unit regarding each patient. These were systematically analysed to understand the rationale provided by each MDT for the treatment recommendations made. Table 4.

Despite the moderate inter-unit agreement, there remained considerable variation in certain patients. We focused on the patients with low agreement levels in order understand the reasons for discordance.

Patient 7 – Split Decision

There was a high level of discordance in treatment recommendations for this 69-year-old male patient with bilateral well functioning hip resurfacings. All units agreed that the patient possessed low risk implants and minimal symptoms. However, units put varying degrees of emphasis on the rising metal ion levels (cobalt 6.7 to 9.8ppb) and the high inclination of the cup as seen on Xray.

Figure 1a.

The two units recommending simple follow up felt the rise in metal ions was not significant in a patient with bilateral MOM hip implants, and were reassured by the lack of symptoms in an active patient. The two units recommending revision surgery, did so on the premise that the cup of the left hip had an excessive inclination, which in the presence of rising metal ion levels and small fluid collection seen within the soft tissues mandates revision surgery. Figures 1b.

Patient 4 – 67% agreement

A female patient with bilateral MOM hip implants, both of which are functioning well with minimal symptoms (OHS 45-47). Blood metal ion (cobalt 2.5ppb) levels were well below the MHRA threshold and imaging including MRI revealed peri-acetabular osteolysis. Figure 2.

All units commented on the risk profile of the implants in this patient:

> *"Minimally symptomatic in female patient with recalled MOM right total hip replacement and asymptomatic resurfacing in the left hip"*

All units commented on the low metal ion levels. Five units commented on the peri-acetabular osteolysis affecting the right hip more than the left. Of these five units, three requested a CT scan, one requested repeat Xray and the fifth an MRI scan, in order to define the pathology further. However, two units committed to early revision for the following reason:

> *"Severe peri-acetabular bone loss, will progress leading to more complicated surgery therefore revise early. CT required to evaluate this in 3D"*

Patient 8 – 67% agreement

This patient was a 75-year-old female with a right sided hip resurfacing. Metal ion levels were moderately raised although the interval change was minimal (cobalt 6.0 to 7.5ppb). Serial MRI revealed evidence of synovitis and pseudotumour, however these were unchanged on serial imaging over 2 years. Figure 3a and 3b. Four units advised revision based on the soft tissue changes and the rising metal ion levels. However, two units emphasised that changes were relatively stable on serial assessment and therefore recommended follow up instead, but did recognize that revision in the future was likely.

Discussion

We compared the management of MOM hip patients across a collaborative international group of orthopaedic centres of excellence. We demonstrated a moderate inter-unit agreement, however, commonly encountered clinical scenarios still split opinions on the best form of management to offer. We used quantitative methods to highlight any differences, followed by qualitative research methods to understand the factors leading to the variation in decision-making. Areas of contention were interplay between patient function and investigation findings, particularly for:

Rising metal ions

Management of osteolysis

Revision for pseudotumour

There appears to be considerable debate as to the best management of patients with failing/symptomatic MOM hip implants. International regulatory authorities have published guidance for surgeons [1-3, 8]. Guidelines are most appropriate for situations in which there is little variability among cases and a strong evidence base, both of which are lacking when considering the long-term outcomes of patients with MOM hip implants. To compound this further, variation between the various guidelines leads to differences in the management of patients on the frontline. This variation reflects the lack of evidence supporting the guidance.

Metal ion levels remain an area of contention. Currently the threshold for concern as set out by the MHRA is 7ppb. However, since the 7ppb level was derived from research based on hip resurfacings [14], it has been postulated that this may not apply to stemmed implants. A study including a variety of implant types demonstrated improved sensitivity and specificity with a cobalt level of 4.5ppb in

stemmed implants [15]. Thresholds for revision are not clearly defined. A recent study demonstrated that a metal ion level should not be used in isolation to determine the need for revision, but what was clear was that higher levels of blood metal ions were a strong predictor of a failing MOM hip implant [16]. Predictably metal ion levels do fall after revision [17, 18].

In this study, some units reported poor cup position in relation to raised or rising metal ion levels as a cause for concern, leading to the recommendation of hip revision surgery. However cup position has been shown to be a poor predictor of failure and does not correlate with metal ion levels [19, 20].

Revision for pseudotumour is also poorly defined. Pseudotumours can exist in symptomatic and asymptomatic patients [21, 22]. What is relevant is whether pseudotumours progress over time, and several studies have attempted to report this, however this remains inconclusive [23-27].

The presence of osteolysis surrounding MOM hip implants appears to be under-reported as a consequence of metal debris [28]. The morphology of bone may be affected by cobalt and chromium through effects on osteoblasts and osteoclasts, which may ultimately lead to osteolysis [29-31]. As a subsequent complication, poor bone in-growth and therefore failure of fixation of revision acetabular cups has been reported after revision MOM hip surgery [32].

The use of multidisciplinary teams (MDT) have been shown to be an effective tool in aiding surgeons to manage MOM hip patients with complex problems [4]. The benefits of MDT meetings are higher-quality decision-making and improved outcomes through the ability of a panel of experts to pool knowledge and experience in providing a balanced viewpoint. An expert panel can offer their combined tacit knowledge and experience of hip revision surgery when making

recommendations; such knowledge and experience cannot be transmitted in any written guideline.

Despite this, variation between different MDT management plans further highlights the need for better guidance as seen in this study. However, lack of guidance may not be the only reason for the variation seen, since each unit will have a uniquely different experience in the management of MOM hip implants. This experience is summarised in Table 5, and demonstrates that each unit has extensive experience, however considerable variation exists in the number of primaries implanted. Each unit has revised a similar number of cases except for the COXA unit, which has a large burden of ASR (Depuy Synthes, Warsaw, Indiana) implants that have been revised. It is sensible to conclude that such variation in operative experience, the implants used and revision techniques utilised by individual units will have a bearing on the decision made in the MDT setting. Furthermore, the effect of this differing experience and its impact on the variation in management seen in this study is difficult to assess, and certainly the resulting effect on patient outcome is not possible to quantify.

Future consensus will only be achieved with large-scale clinical trials and long-term follow-up studies. However, since the majority of MOM hip implants are no longer in use, and the "at risk" cohort of patients is steadily declining, the likelihood of large scale studies being conducted is small. It would be logical to assume that variation between individual surgeons would be much greater given the demonstration of inter-unit MDT variation here. Therefore, shared decision-making, as in the MDT approach, is likely to reduce outlier activities of individual surgeons.

One disadvantage of an MDT meeting is the disconnection between the patient's wishes and the opinion of the expert panel, which can sometimes be overlooked. This was seen for patient 10, where the patient had expressed a desire to avoid surgery. Five units subsequently recommended surgery and therefore overlooked this in the patient's history. It is important to recognise the need for shared decision-making, between the patient and the surgeon. One centre within this study, offered a primary management plan followed by an alternative management plan should the patient not agree. This should be a feature of such MDT meetings.

Before embarking on this study, it was hypothesised that variation existed depending on the guideline being followed, where the national regulatory authority guides each centre. However variation between units within the same country disproved this hypothesis. Instead the use of thematic analysis helped us to identify the reasons for discordance on a case-by-case basis.

Conclusion

Variation exists in the management of MOM hip patients. A lack of adequate evidence for some themes used to justify decision-making in the management of MOM hip implants provides a strong rationale for the use of an MDT approach for these patients. This reduces the likelihood of outlier decision-making in the absence of uniform guidance.

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Pt	1	2	3	4	5	6	7	8	9	10
	Metal Ion Dilemmas			Bone	Soft Tissue Dilemmas				Other	
Age	71	64	56	49	75	76	69	75	61	67
Sex	M	M	F	F	F	F	M	F	F	M
Implant	THR	THR	HRA	R-THR / L-HRA	THR	THR	HRA	HRA	THR	THR
Laterality	Right	Bilateral	Bilateral	Bilateral	Left	Right	Bilateral	Right	Right	Left
Time in-situ (months)	90	R88/L90	R84/L114	R102/L129	95	91	R133/L127	92	68	92
OHS	47	48	R22/L42	R47/L45	29	31	R43/L47	24	6	44
Cobalt	6.2	12.1	54.2	2.5	5.4	1.0	6.7 » 9.8	6.0 » 7.5	22.0	9.5
Chromium	4.4	3.6	26.0	2.7	6.3	0.7	7.2 » 8.7	3.3 » 4.1	12.0	2.2
CRP	1	1	9	1	2	8	1	11	12	6
Symptoms	Mobile and happy. Twinge on bending. Unlimited activities.	Excellent function, occasional pain right thigh.	Right – Constant ache, walking distance limited. Left – no symptoms	Right – hip aches after long periods of use. Left – occasional pain, difficulty bending	Pain worsening since operation. Leg length unequal (long on left). Uses stick to mobilise.	Pain in groin, walks short-legged gait. Pain on turning. (Multiple medical co-morbidities)	Right – episodic lateral hip pain, previous subluxations improved with cycling. Left – occasional ache.	Uses crutches outdoors, some clicking in hip. Occasional pain to anterior thigh.	Well functioning for 5 years, now developed groin and buttock pain.	Painless hip, however palpable groin lump. Active and mobile.
Examination	Pain free ROM.	Pain free ROM	Right – painful flexion. Left – Full ROM	Right – Pain free. Left – painful ROM.	Good ROM, painful over trochanter	Painful ROM	Full pain free ROM.	Slight restriction to ROM	Full ROM, irritable on rotation	Palpable anterior groin lump. Good ROM.
MRI	Effusion and mild synovitis	Effusion and moderate synovitis	Effusion and moderate synovitis	Superior pubic ramus osteolysis (right)	Left cystic PS with disruption of abductor attachment	Posterior cystic PS	Fluid over left Greater Trochanter	Cystic PS anterior and posterior to hip (stable on serial exam)	Right hip synovitis, Left hip anterior cystic PS	Anterior cystic PS with interval increase in debris contents
Patient Expectation	Will be advised	Keen to avoid surgery	Will be advised	Will be advised	Will be advised	Will be advised	Will be advised	Will be advised	Will be advised	Keen to avoid surgery

Table 1: Demographic, clinical and imaging details for the patient cohort studied. Note Cobalt and Chromium given in Parts Per Billion. MRI = Magnetic Resonance Imaging, OHS = Oxford hip Score (max = 48), CRP = C-Reactive Protein, PS = Pseudotumour, Sex M = male, F = female, THR = Total Hip Replacement, HRA = Hip Resurfacing Arthropalsty, ROM = Range of Movement.

Stages of thematic Analysis				
Raw Data	Initial Codes	Focused Themes	Review	Application of Theory
This is a 67-year-old female with a modular total hip replacement, which is a high-risk implant. She complains of constant pain, and is limited in her function. Her metal ion levels are raised (10ppb) and there is evidence of a pseudotumour on MRI scanning. We recommend revision surgery.	Comment on patients demographics Type of implant and its risk profile Patients symptoms including functional status Quantification of metal ion levels Findings on cross sectional imaging - pseudotumour	Patient demographic High risk implant Symptomatic High blood metal levels Imaging findings - pseudotumour	Frequency of themes across 6 centres Degree of agreement between centres	Application to current evidence base to prepare final report: for example the current threshold for concern of metal ions recommended by the MHRA is 7ppb

Table 2: A simplified representation of the application of thematic analysis used to understand the rationale behind management decision-making

Pt	RNOH	COXA	ENDO	Wright	MGH	HSS	Majority Agreement (%)	P
1	Investigate	Investigate	Investigate	Investigate	Investigate	Monitor	83	0.01
2	Investigate	Investigate	Investigate	Investigate	Investigate	Investigate	100	<0.01
3	Revise	Revise	Revise	Revise	Revise	Revise	100	<0.01
4	Investigate	Investigate	Revise	Revise	Investigate	Investigate	67	0.03
5	Revise	Revise	Investigate	Revise	Revise	Revise	83	0.01
6	Investigate	Investigate	Revise	Investigate	Investigate	Investigate	83	0.01
7	Monitor	Investigate	Investigate	Revise	Monitor	Revise	33	>0.05
8	Monitor	Revise	Revise	Revise	Monitor	Revise	67	0.03
9	Revise	Revise	Revise	Revise	Revise	Revise	100	<0.01
10	Investigate	Revise	Revise	Revise	Revise	Revise	83	0.01

Table 3: The final management decision recommended by each orthopaedic centre. The associated agreement for each patient, followed by the statistical significance calculated using cumulative multinomial distribution analysis.

Pt	Focused Themes	Outcome Frequency	Max total = 6
1	Asymptomatic / minimal in all	Follow up	All
	High risk implant	Repeat blood tests	5
	Blood Ions moderately raised	Repeat Xray	2
	Minimal imaging finding on MRI (effusion)	Repeat MRI	1
	Possible osteolysis on xray	Revise	0
		Other	-
2	Symptoms (occasional)	Follow up	All
	High Risk Implant	Repeat blood tests	All
	Elevated Co:Cr Ratio	Repeat Xray	0
	Pedestal distal to stem on Xray	Repeat MRI	3
	MRI shows synovitis	Revise	0
	Possible taper corrosion	Other	Hip aspiration
3	Low risk implants	Follow up	-
	Right side symptoms	Repeat blood tests	-
	Small head size	Repeat Xray	-
	Sub-optimal cup position	Repeat MRI	-
	High ions	Revise	All
	Fluid collection	Other	-
4	Minimal symptoms	Follow up	4
	Low metal ions	Repeat blood tests	0
	Sub-optimal cup position on left	Repeat Xray	1
	Osteolysis both hips - ARMD	Repeat MRI	1
		Revise	2
		Other	3 requested CT
5	High risk implant	Follow up	1
	Symptomatic	Repeat blood tests	1
	Moderate ion levels	Repeat Xray	0
	High offset hip	Repeat MRI	0
	Surgical approach related muscle damage	Revise	5
	Pseudotumour and muscle damage	Other	-
6	High risk implant	Follow up	5
	Symptomatic	Repeat blood tests	1
	Pseudotumour	Repeat Xray	0
	Muscle atrophy	Repeat MRI	3
	Xray suggests loose stem	Revise	1
	Oversized head	Other	Hip aspiration
	Multiple co-morbidities		
7	Low risk implants	Follow up	4
	Left suboptimal cup position	Repeat blood tests	3
	Occasional subluxations of right hip	Repeat Xray	0
	Rising metal ions	Repeat MRI	1
	Small fluid collection left	Revise	2
		Other	-
8	Low risk implants	Follow up	2
	Poor OHS and mechanical symptoms	Repeat blood tests	0
	Xrays satisfactory	Repeat Xray	0
	Rising metal ions	Repeat MRI	0
	Fluid / PS that is stable on MRI	Revise	4
		Other	-
9	High risk implant	Follow up	-
	New onset symptoms	Repeat blood tests	-
	High ions	Repeat Xray	-
	High CRP	Repeat MRI	-
	Mild changes on MRI	Revise	All
	Aspirate hip to rule out infection	Other	Aspirate prior to revision (4)
	Revise early to protect soft tissues		
10	High risk implant	Follow up	1
	Asymptomatic	Repeat blood tests	0
	Palpable mass anterior to hip	Repeat Xray	0
	High Co:Cr ratio	Repeat MRI	0
	Pseudotumour anteriorly corresponds to clinical findings	Revise	5
		Other	-
	Serial imaging – stable over time		
	Patient not keen on surgery		

Table 4: Results of thematic analysis – this table demonstrates the common focused themes for each patient as provided by each centre, and also includes a breakdown of the management outcome.

	RNOH	COXA	ENDO	Wright	MGH	HSS
Total MOM Primaries	480	2868	0	468	100	2200
Total MOM Revisions	400	600	250	220	450	300
All Hip Revisions/yr	300	400	1200	300	500	500

Table 5: Demonstrates the variation in experience of each of the six units participating in this study. This includes total MOM hip primaries implanted, total MOM hips revised and all hip revisions undertaken yearly.

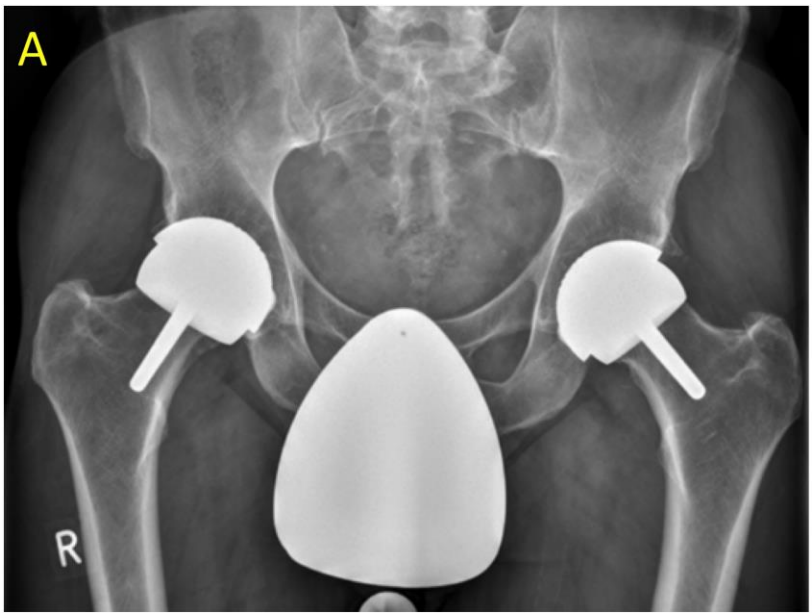

Figure 1a: Anteroposterior pelvis radiograph for patient 7. The left acetabular cup appears to have an excessive inclination

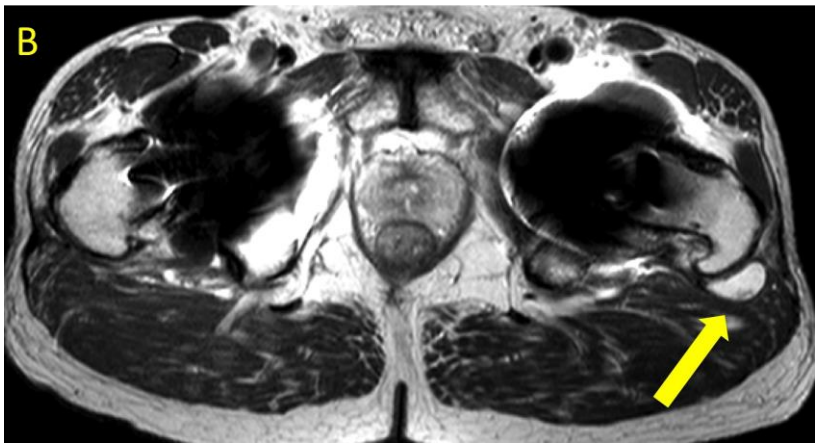

Figure 1b: Axial T2 weighted MARS MRI for patient 7. Yellow arrow demonstrates a small fuid collection over the left greater trochanter.

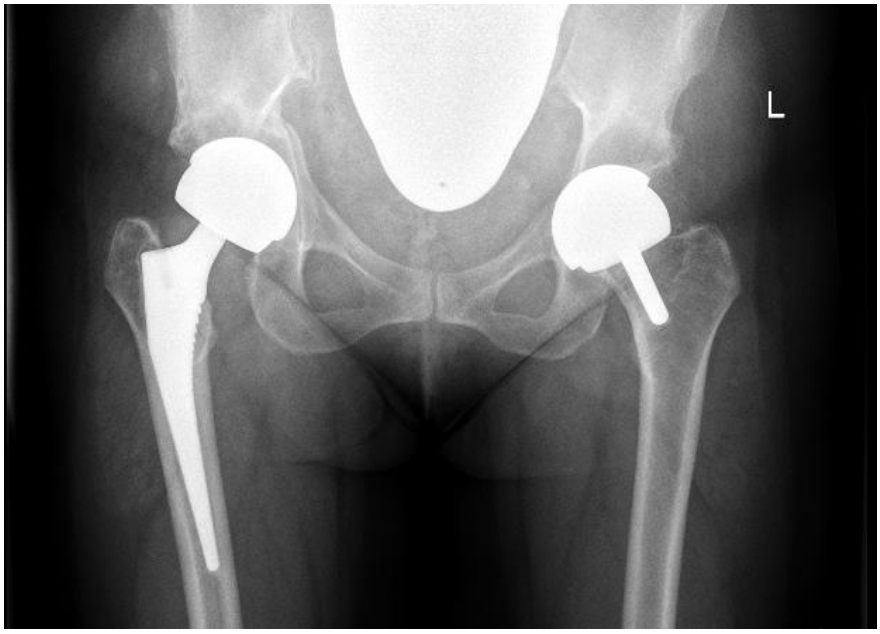

Figure 2: Anteroposterior pelvis radiograph (patient 4) – demonstrating peri-acetabular osteolysis particularly affecting the right hip

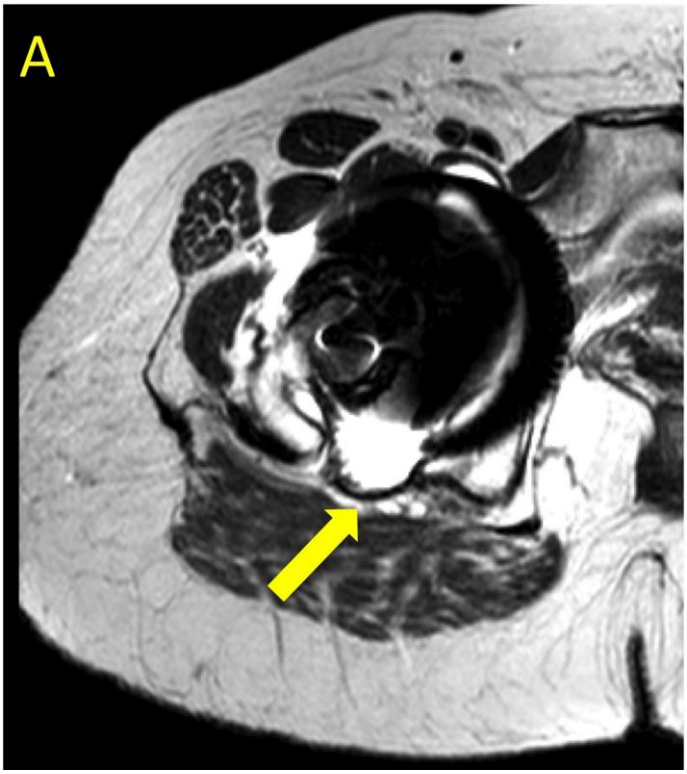

Figure 3a: T2 weighted Axial MRI images for patient 8, demonstrating stable appearances to the cystic pseudotumour (arrow) over a 2-year period from 2012 (3a) to 2014 (3b)

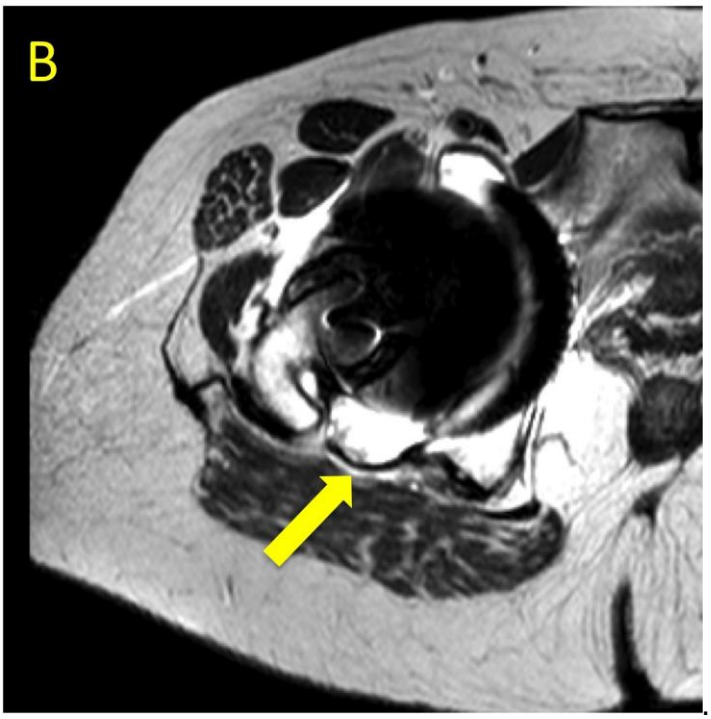

Figure 3b: T2 weighted Axial MRI images for patient 8, demonstrating stable appearances to the cystic pseudotumour (arrow) over a 2-year period from 2012 (3a) to 2014 (3b)

Table and Figure Captions:

Table 1: Demographic, clinical and imaging details for the patient cohort studied. Note Cobalt and Chromium given in Parts Per Billion. MRI = Magnetic Resonance Imaging, OHS = Oxford hip Score (max = 48), CRP = C-Reactive Protein, PS = Pseudotumour, Sex M = male, F = female, THR = Total Hip Replacement, HRA = Hip Resurfacing Arthropalsty, ROM = Range of Movement.

Table 2: A simplified representation of the application of thematic analysis used to understand the rationale behind management decision-making

Table 3: The final management decision recommended by each orthopaedic centre. The associated agreement for each patient, followed by the statistical significance calculated using cumulative multinomial distribution analysis.

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