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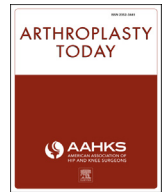
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## Case report

## Intraoperative femoral head dislodgement during total hip arthroplasty: a report of four cases

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## ABSTRACT

Dislodgment of trial femoral heads and migration into the pelvis during total hip arthroplasty is a rarely reported complication with limited published cases. There are three primary mechanisms of femoral head separation: dislodgement during reduction attempt, disassociation from anterior dislocation while assessing anterior stability, and during dislocation after implant trialing. If the trial femoral migrates beyond the pelvic brim, it is safer to finish the total hip arthroplasty and address the retained object after repositioning or in a planned second procedure with a general surgeon. We recommend operative retrieval since long-term complications from retention or clinical results are lacking.

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## Introduction

Total hip arthroplasty (THA) is one of the most successful and cost-efficient procedures in medicine; however, complications may occur up to 22% [1–4]. Dislodgement of trial femoral heads and migration into the pelvis is a rarely reported complication with only 14 published cases [5–18]. Although a handful of reports are described in the literature, the true incidence of this complication is unknown. We present 4 cases of femoral head disassociation into the pelvis and evaluate different variables that place patients at a higher risk for this complication (Table 1). We also provide an algorithm and recommendations for management based on cumulative experience and literature review.

## Case histories

## Case 1

A 63-year-old female with body mass index (BMI) of 46.1 kg/m<sup>2</sup> and history of deep vein thrombosis and hypertension underwent a

left cementless THA using a minimally invasive Watson-Jones approach [19] in the lateral decubitus position. After placement of the acetabular component and broaching of the femur for a taper wedge stem, a trial reduction was performed with a lateralized offset neck and a 36-mm +5 head. During the reduction process, the trial head dissociated from the neck and dislodged into the iliopsoas sheath through the rent from the anterior capsulotomy (Fig. 1). Multiple unsuccessful attempts were performed with curved Kelly clamps and inflation of a Coude catheter. The THA was completed in a routine manner with an intraoperative consult to general surgery. Immediately after closure, the patient was repositioned in a supine position to allow access to the retroperitoneum via a left ilioinguinal approach for successful retrieval. The patient was immediately mobilized without restrictions postoperatively and discharged home on postoperative day 2, without further complication.

## Case 2

A 45-year-old male with BMI of 30.1 kg/m<sup>2</sup> and history of right indirect inguinal hernia repair underwent left cementless THA via a traditional posterior approach. Before trialing, large anterior, inferior, and posterior marginal osteophytes were removed after polyethylene liner placement. After broaching a fit and fill stem, a 28-mm +2.5 trial head was used for range of motion and stability assessment. At extreme extension and external rotation, the femoral neck abutted the posterior wall and the hip dislocated

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**Table 1**  
Case history summary.

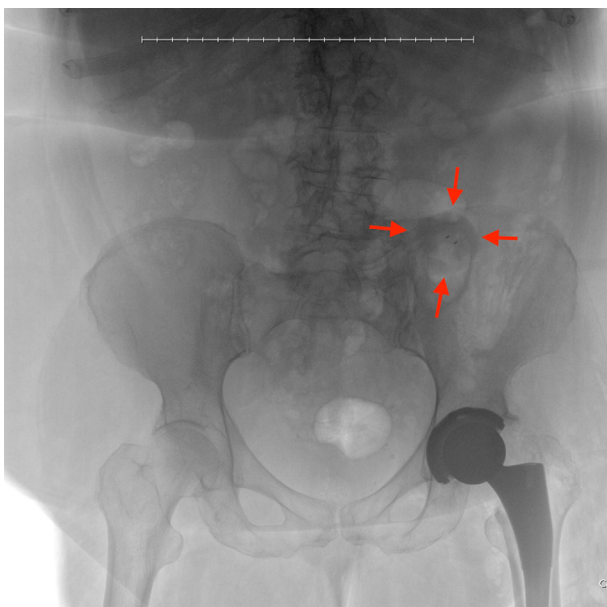
Patient	Age, y	Gender	BMI, kg/m <sup>2</sup>	Approach	Vendor	Mechanism	Trial head size	Morse taper	Imaging	Retrieval	Timing	Retrieval approach
1	63	F	46.1	Anterolateral MIS	DePuy Synthes	Reduction attempt	36 mm +5	12/14	XR	Yes	Initial operation	Ilioinguinal
2	45	M	30.1	Posterior	Stryker Osteonics	Anterior stability assessment	28 mm +2.5	V40	XR	Yes	Initial operation	Ilioinguinal
3	68	F	30.2	Posterior	Stryker Osteonics	Dislocation after trialing	28 mm +7	V40	XR	Yes	Initial operation	Ilioinguinal
4	55	F	42.8	Mini posterior	Zimmer Biomet	Anterior stability assessment	32 mm +5	12/14	XR	Yes	Initial operation	Modified Stoppa

XR, x-ray.

anteriorly causing head dislodgement along the anterior pelvic brim. Multiple unsuccessful attempts including a trochanteric osteotomy were performed to retrieve the trial head. Similar to case 1, the final components were implanted and the patient was repositioned for an ilioinguinal approach by general surgery. The trial was retrieved underneath the psoas fascia. The patient progressed well postoperatively without complications with a healed osteotomy site at the latest follow-up at 5 years.

#### Case 3

A 68-year-old female with BMI of 30.2 kg/m<sup>2</sup> with history of hypertension and anemia underwent a left cementless THA through a posterior approach. During the dislocation process after trialing the implants, the 28-mm +7 trial femoral head was disassociated from the fit and fill stem trunnion and progressed along the psoas sheath. The trial head was irretrievable through the posterior incision. After final component implantation, the patient was positioned supine for general surgery to perform an ilioinguinal approach to retrieve the trial head. After successful retrieval, the patient was permitted to weight bear as tolerated postoperatively with an uneventful hospital course and no further complications.



**Figure 1.** Inverted kidney, ureter, and bladder (KUB) radiograph demonstrating subtle radio-opaque density (arrows) with 2 metallic dots inside the trial femoral head.

#### Case 4

A 55-year-old female with BMI of 42.8 kg/m<sup>2</sup> and history of hypertension and coronary artery disease underwent a left cementless THA with a mini posterior approach. During the trial reduction, while assessing anterior stability with hip extension and external rotation, the 32-mm +5 trial head dislocated of the fit and fill stem and slipped anteriorly into the psoas sheath. While manually palpating along the sheath, the trial femoral head moved further into the sheath and pelvis. After multiple failed rescue attempts, the patient was repositioned supine after final component implantation. A lateral window modified Stoppa approach was used to obtain femoral head within the iliacus muscle. The remainder of the patient's hospital course was routine with home discharge on postoperative day 2 without further complication.

#### Discussion

Despite great clinical outcomes and patient satisfaction rates [20], intraoperative complications during THA are not uncommon, occurring in approximately 5.4% of cases, with femur fractures occurring most commonly [21]. Trial femoral head dislocation into the retroperitoneum is a much rarer complication with limited previous reports (Table 2) [5–18]. Although the overall occurrence rate is undetermined, the incidence of this complication at our institution for 34,198 primary THAs from 1998 to present was extremely rare at 0.01%.

#### Mechanism of disassociation

There are three primary mechanisms of femoral head separation: dislodgement during reduction attempt, disassociation from anterior dislocation while assessing anterior stability, and during dislocation after implant trialing. Although our patients suffered this complication from all three mechanisms, dislocation after stability assessment has been described most frequently in 11 patients [5,7–11,13,15–17]. Four patients [6,14] lost femoral heads after anterior stability evaluation, 2 patients [6,12] from attempted hip reduction for trialing, and 1 patient during reduction after implantation of final components [18]. The femoral head most commonly dislodges along the anterior pelvic brim with majority migrating adjacent, beneath or along the iliopsoas through the lacuna musculorum of the inguinal canal into the iliac fossa [16]. However, one study reported migration within the pelvic quadrilateral space related to accidentally pushing the trial inferiorly during retrieval attempt [14].

Anterior dislodgement occurred in all our patients (1 anterolateral and 3 posterior) and reported cases regardless of surgical approach (4 anterolateral [5,7,13], 4 direct lateral [8,9,12,15,18], and 9 posterior [6,10,11,14,17]). This may be ascribed to the soft tissue rent created in the anterior capsule for retractor placement in all approaches. Two

**Table 2**  
Cumulative summary of studies reporting dislocated femoral heads.

Study	Journal	Country	Approach	Vendor	Mechanism	Trial head size	Imaging	Retrieval	Timing	Retrieval approach
Alfonso et al. [7]	JBJS, 2006	USA	Anterolateral	Stryker, USA	Dislocation after trialing	-	CT	Yes	1 d	Laparoscopy
Batouk et al. [8]	JBJS, 2001	Canada	Direct lateral	Smith & Nephew, USA	Dislocation after trialing	28 mm	CT	No	-	-
Callaghan et al. [6]	Iowa Ortho. Journal, 2006	USA	Posterior Posterior Posterior Posterior	-	Anterior stability assessment: Cases 1, 2, and 4 Reduction attempt: Case 3	26mm 28mm - -	XR	Case 1: no Case 2: yes Case 3: yes Case 4: yes	- 6 wk postoperative Same day Same day	- Ilioinguinal Ilioinguinal Ilioinguinal
Citak et al. [17]	Open Ortho. Journal, 2013	Germany	Posterior	Waldemar LINK, Germany	Dislocation after trialing	28 mm	CT	Yes	Early postoperative period Same day	Laparotomy
Hamoui et al. [10]	Eur J Orthop Surg Traum., 2011	France	Posterior	Zimmer, USA	Dislocation after trialing	28 mm	CT	Yes	Same day	Ilioinguinal
Ikeuchi et al. [14]	Nagoya J. Med. Sci, 2014	Japan	Posterior Posterior	Stryker, USA	Anterior stability assessment	26 mm 28 mm	CT	Case 1: no Case 2: yes	Initial operation	Extended hip incision
Kalra et al. [12]	JOA, 2011	USA	Direct lateral—revision THA	Zimmer, USA	Reduction attempt	36 mm	-	Yes	Initial operation	Separate posterior hip incision
Madsen et al. [5]	JOA, 2012	USA	Anterolateral Anterolateral	DePuy, USA	Dislocation after trialing	36 mm 28 mm	=	Yes	Initial operation	Extended hip incision
Princep et al. [15]	JBJS, 2002	USA	Direct lateral	-	Dislocation after trialing	-	-	Yes	Initial operation	Extended hip incision
Rachbauer et al. [16]	JBJS, 2002	USA	-	-	Dislocation after reduction	-	-	Yes	Initial operation	Ilioinguinal
Vertelis et al. [11]	Cases Journal, 2008	Lithuania	Posterior	-	Dislocation after trialing	28 mm	CT	No	-	-
Ziv et al. [13]	Can J Surg, 2008	Canada	MIS Anterolateral	DePuy, USA	Dislocation after trialing	28 mm	Fluoroscopy	Yes	Initial operation	Ilioinguinal
Bicanic et al. [9]	BMJ, 2015	Croatia	Direct lateral	Lima Corporate, Italy	Dislocation after trialing	28 mm	CT	Yes	6 mo after PJI	Ilioinguinal
Ozkan et al. [18]	Acta Orthop. Belg., 2008	Turkey	Direct lateral	Smith & Nephew, USA	Final reduction after implantation	22 mm	XR	No	-	-

CT, computerized topography; JBJS, Journal of Bone and Joint Surgery; JOA, Journal of Arthroplasty; MIS, minimally invasive surgery; PJI, periprosthetic joint infection.

**Table 3**  
Risk factors for femoral head dislodgement.

Risk factors						
Obesity	Study	BMI (average kg/m <sup>2</sup> )	BMI (range kg/m <sup>2</sup> )	Conclusions		
	This series	38	30–46.1	<ul style="list-style-type: none"> <li>• Obesity causes:               <ul style="list-style-type: none"> <li>◦ Increased soft tissue tension</li> <li>◦ Decreased visualization</li> </ul> </li> <li>• Obesity not sole risk factor</li> <li>• Obesity not sole risk factor</li> <li>• Weight loss and increased tissue softening increases risk</li> </ul>		
	Alfonso et al. [7]	23.4	-			
	Citak et al. [17]	23.1	-			
	Rachbauer et al. [16]	-	-			
Femoral head size	Study	Head size	Conclusion			
	This series	28 mm 28 mm 28 mm 32 mm 36 mm	<ul style="list-style-type: none"> <li>• Reduced head-neck ratio increase impingement and instability</li> </ul>			
	Batouk et al. [8]	28 mm				
	Callaghan et al. [6]	26 mm 28 mm				
	Citak et al. [17]	28 mm				
	Hamoui et al. [10]	28 mm				
	Ikeuchi et al. [14]	26 mm 28 mm				
	Kalra et al. [12]	36 mm				
	Madsen et al. [5]	36 mm 28 mm				
	Vertelis et al. [11]	28 mm				
	Ziv et al. [13]	28 mm				
	Bicanic et al. [9]	28 mm				
	Ozkan et al. [18]	22 mm				
Implant system	Vendors with complication	Conclusion				
	Stryker Howmedica Osteonics DePuy Synthes Zimmer Biomet Smith & Nephew Lima Corporate Waldemar LINK	<ul style="list-style-type: none"> <li>• This complication can occur with multiple system</li> </ul>				

authors further described an extensive anterior capsulectomy during their direct lateral approach, which removes a structural anterior restraint and direct access to the pelvic brim and psoas sheath [8,18]. Regardless of surgical approach, special attention to the head and neck should be emphasized with the use of modular components during reduction, stability trialing, and dislocation.

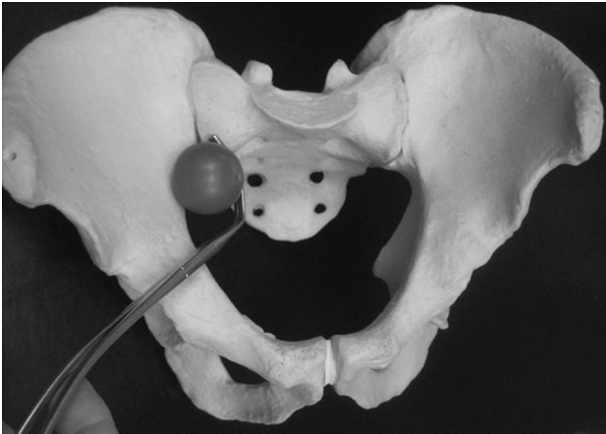
#### Risk factors

##### Obesity

As femoral head disassociation is a rare occurrence, it is difficult to extrapolate definitive associations from case reports (Table 3). However, all patients in our series were obese with a BMI of 37.3 kg/

**Table 4**  
Management of disassociated femoral head.

Retention of trial head	Study	Follow-up, mo	Conclusion
	Batouk et al. [8]	3	<ul style="list-style-type: none"> <li>• Patients may function without pain with trial head retention</li> </ul>
	Callaghan et al. [6]	24	
	Ikeuchi et al. [14]	36	
	Vertelis et al. [11]	8	
	Ozkan et al. [18]	3	
Hip incision extension	Study	Hip approach	Retrieval technique
	Madsen et al. [5]	Anterolateral	<ul style="list-style-type: none"> <li>• Large Satinsky aortic clamp used for retrieval</li> <li>• Trial head location readjusted with fingers and retrieved from sciatic notch</li> <li>• Manual anterior wall compression with downward pressure on the groin to prevent head progression</li> <li>• Manual finger use to grab femoral head along inner pelvic table</li> </ul>
	Kalra et al. [12]	Lateral	
	Ikeuchi et al. [14]	Posterior	
	Princep et al. [15]	Lateral	
Intraoperative general surgery consult	Study	Approach	Conclusion
	Callaghan et al. [6]	Ilioinguinal	<ul style="list-style-type: none"> <li>• The ilioinguinal approach is the workhorse for trial head retrieval from the retroperitoneum</li> </ul>
	Alfonso et al. [7]	Laparoscopy	
	Bicanic et al. [9]	Ilioinguinal	
	Hamoui et al. [10]	Ilioinguinal	
	Ziv et al. [13]	Ilioinguinal	
	Rachbauer et al. [16]	Ilioinguinal	
	Citak et al. [17]	Laparotomy	

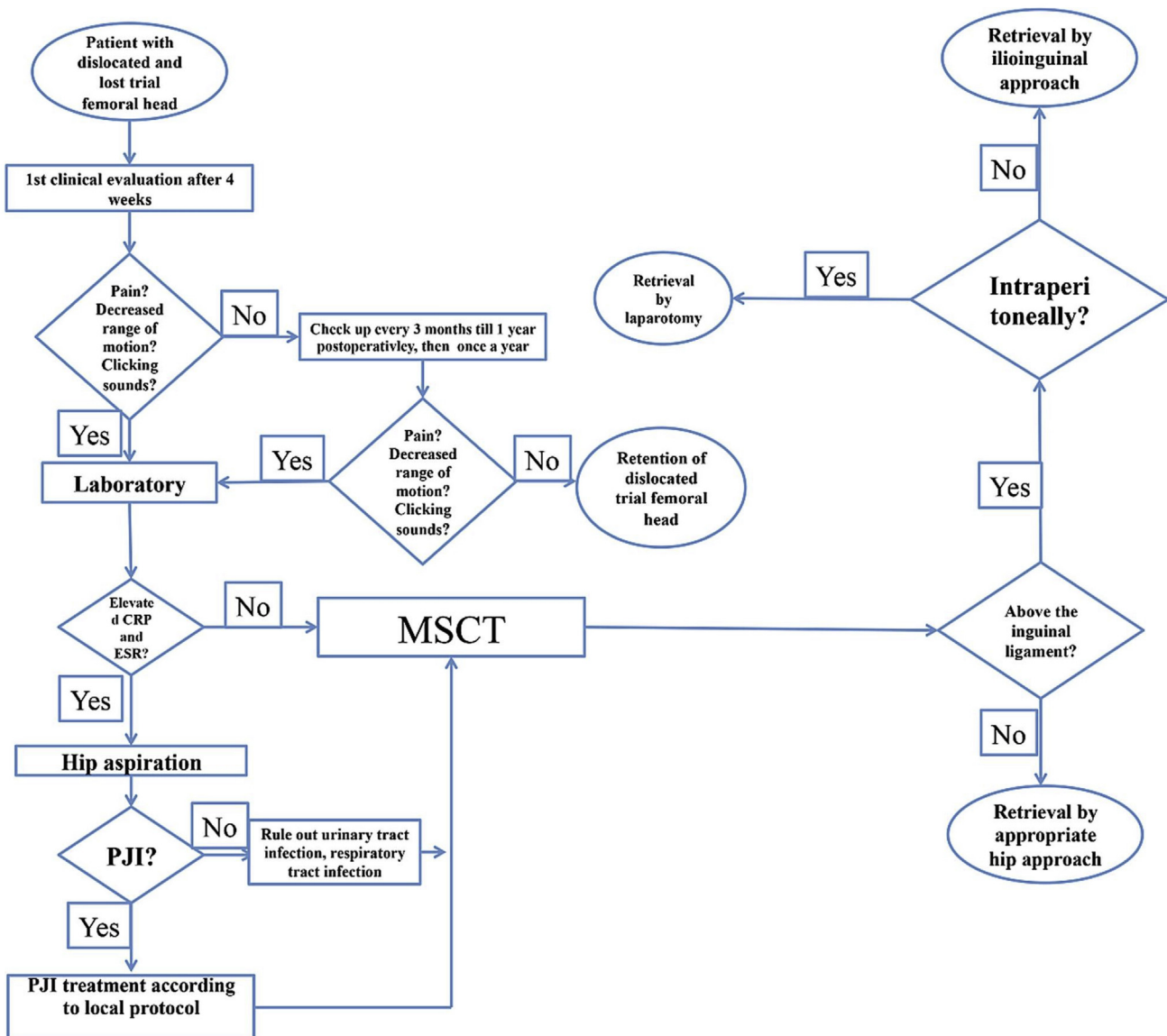


**Figure 2.** Retrieval of a lost femoral trial head deep in the pelvis using a Satinsky aortic clamp. (Reproduced with permission from Madsen et al. *Journal of Arthroplasty*, Elsevier, 2012.)

m<sup>2</sup> (range 30.1–46.1 kg/m<sup>2</sup>). Increased BMI is a significant risk factor for THA instability and dislocation [21–23], which may cause increased impingement on the posterior acetabular brim and subsequent modular component disassociation. Intraoperative soft tissue tension may be greater with decreased visualization in obese patients further increasing the likelihood of this complication. However, some authors also report this occurrence in patients with lower BMI relating to increased soft tissue softening from adipose attenuation [7,16,17]. Further investigation is needed to evaluate obesity and BMI as a risk factor.

*Femoral head size*

Small femoral head size and reduced head-neck ratio are well-established causes of THA impingement and instability [24]. In our series, most patients had 28-mm trial heads similar to previous reported literature. The reduced head-neck ratio consistently caused posterior impingement and subsequent femoral head disassociation. However, in one patient in our series, the complication did occur with a 36-mm trial femoral head.



**Figure 3.** Algorithm for decision-making and treatment for the dislocated trial femoral head. MSCT, multislice CT; PJI, periprosthetic joint infection. (Reproduced with permission from Bicanic et al. *BMJ Case Reports*, 2015.)



Dislodgement could further be facilitated from worn out trials from repeated sterilization, which prevents desired snug fit between the modular junctions [7]. Although decreased femoral head-neck ratio may be a risk factor, the occurrence with 36-mm trial heads and the use of plus size heads and its effect on soft tissue tensioning implies the multifactorial nature of this problem.

#### Implant design

Different hip implant companies have varying implant design types, Morse taper sizes and variable trial head locking mechanisms on the trial neck. One of the more common trunnion tapers in use is the 12/14 taper [25,26]. Although many vendors distribute stems with tapers under this type, each implant manufacturer uses a different and unique Morse fit with varying tolerances and therefore are not all the same [25,26].

Our case series demonstrated this complication with the use of two different implant designs, type 1 single wedge and type 3A fit and fill stems as classified by Mont et al. [27], with 3 different taper sizes (V40, 12/14, and 12/14) from three separate systems (Stryker Howmedica Osteonics [Mahwah, NJ], DePuy Synthes [Warsaw, IN], and Zimmer Biomet [Warsaw, IN]). Previous studies have also reported the issue with multiple systems (Stryker, Zimmer Biomet, DePuy Synthes, and Smith & Nephew [Memphis, TN]) including European companies such as Lima Corporate (Villanova di San Daniele del Friuli, Italy) and Waldemar LINK (Hamburg, Germany). As this complication is not vendor, implant design, or Morse taper size specific, increased focus on exposure, soft tissue tension, and careful stability evaluation should be emphasized.

#### Management

Although retrieval of the trial head in the retroperitoneum may seem critical, the sterile plastic femoral head is produced from an inert acetyl copolymer resin, and some reports suggest that leaving the head in the abdomen may be safe [8] (Table 4). Twenty-seven percent patients (5 of 18 patients) [5–18] were managed with femoral head retention in the abdomen with pain-free follow-up of 3 years [14]. However, situations that warrant prompt head removal include symptomatic compression on nerves, vessels, or ureter. Alfonso et al. [7] also suggested a theoretical risk of erosion into the gastrointestinal tract. Therefore, routine retrieval of the foreign body is recommended.

Hip incision extension for retrieval has been reported by 4 authors [5,12,14,15].

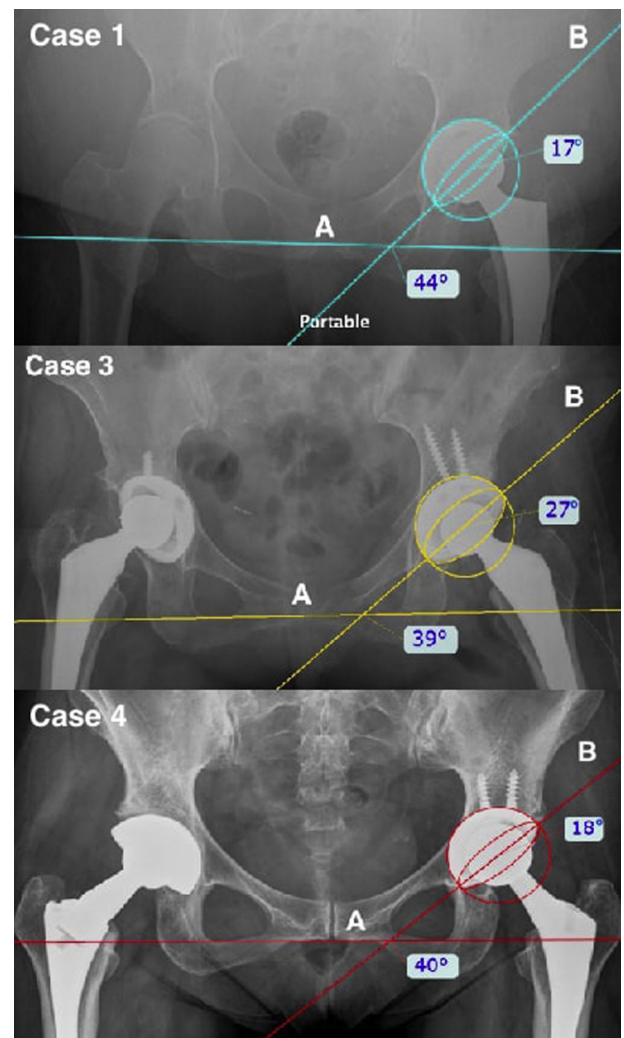
Madsen et al. [5] described using a large Satinsky aortic clamp underneath the psoas bursa for retrieval (Fig. 2). Ikeuchi et al. [14] suggested prevention from further head dislodgement in the psoas sheath by manual anterior wall compression with downward pressure on the groin to help retrieval within the hip wound with a Kocher. Princep [15] reported successful retrieval after enlarging the rent on the anterosuperior aspect of the acetabulum that was initially made for cobra retractor insertion. After 2 cm enlargement of the hole and hip flexion, the authors were able to manually finger grasp the femoral head along the inner pelvic table. Most frequently, however, an intraoperative general surgery consult is needed for retrieval from a separate abdominal surgical approach [6,7,9,10,13,16,17]. The most commonly described surgical method is the ilioinguinal approach, although laparoscopy and laparotomy have also been reported [7,17].

There is no consensus regarding surgical timing for trial head removal. Our patients were managed by general surgery during the index procedure. Interestingly, Bicanic et al. [9] reported a patient diagnosed with a *Staphylococcus epidermidis* periprosthetic joint infection and attributed increased surgical time for head retrieval

as a periprosthetic joint infection risk and recommended a second planned operation according to their algorithm (Fig. 3).

Advanced imaging before retrieval is also debatable. As trial heads are radiolucent on plain films, some surgeons recommend obtaining computerized tomography scan and delaying the secondary surgery [7,9,10,17]. The safe location of the trial seen on computerized tomography, such as within the iliac muscle, can sometimes influence the decision for clinical observation [8,11,14].

Appropriate intraoperative preventive measures for this rare complication are crucial. Despite less soft-tissue trauma, reduced blood loss and faster recovery from minimally invasive [28,29], the surgeon needs to be mindful of the soft-tissue tension during component trialing and implantation, especially in obese patients. Poor visualization and excess tension may be primary culprits of lost femoral heads. Attempting to grab the trial blindly by tactile feel should be avoided as this can further push the head deeper into the abdominal cavity [8,14]. Acetabular components should be positioned within the safe zone [30] and not in excess cup anteversion in the setting of anterior capsulectomy to reduce



**Figure 4.** Supine anteroposterior pelvis radiographs from case 1, case 3, and case 4 showing measurements for cup anteversion and abduction angles within the Lewinnek safe zone [30]. Line B is the tangent line to the opening of the acetabular cup and intersects with the interobturator reference line A on the pelvis providing the abduction angle. The ellipse that measures the anteversion angle is shown by the contour of the acetabular cup opening and is concentric with the circle surrounding the acetabular cup. The measurements were done after calibration using the TraumaCad software.

impingement, instability, and inadvertent dislocation, especially during trialing (Fig. 4). Furthermore, it may be prudent during a posterior approach to avoid osteophyte excision and anterior capsulotomy until after final components are implanted to help mitigate the risk for this complication. If a large anterior capsulectomy is performed beforehand, one author recommends placing gauze along the anterior rim as a catch net during trialing to prevent femoral head extravasation if disassociation occurs [14].

It is also critical to ensure a secure head-neck fit before trialing. As the head-trunnion impaction is relatively loose in most systems, a novel “necklace” technique of 2 heavy braided sutures being threaded with a knot through the apical holes of the trial heads has been described [7]. Although the suture method is quick safety net, it is less commonly used as it may interfere with trialing and is an additional step in the surgical workflow. Finally, it is also critical to ensure adequate Morse fit after final impaction, as Ozkan et al. [18] reported femoral head separation of the final implant after anterior acetabular rim impingement.

## Summary

We present a unique series of THA trial femoral head disassociation with different surgical approaches and implant systems. It is essential surgeons follow preventative measures during trialing and ensure secure head-neck impaction. If a femoral head is dislodged into the pelvis and can directly visualized, retrieval within the wound is advised. However, if it migrates beyond the pelvic brim, it is safer to finish the THA and address the retained object after repositioning or in a planned second procedure with a general surgeon. We recommend operative retrieval since long-term complications from retention or clinical results are lacking.

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