MRI Evaluation of Posterior Capsular Dehiscence Following THA

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Purpose

This study was designed to evaluate the use of MRI to diagnose posterior capsule dehiscence following posterior approach THA with capsular repair, and its association with post-operative posterior hip dislocation.

Our hypothesis is that MRI can serve as an effective diagnostic tool for diagnosing post-operative posterior capsular dehiscence.

This offers the potential to identify those patients who may require further intervention to prevent dislocations.

Target Audience

- Musculoskeletal radiologists working in close conjunction with adult reconstruction surgeons.
- Orthopaedic surgeons who perform total hip arthroplasties.
- Any physician wishing to learn more about complications of hip arthroplasties.

Introduction to study

Component dislocation following total hip arthroplasty (THA) is a primary cause of poor patient outcomes. The most common approach to THA, the posterior approach, involves a dissection through the posterior capsule, and posterior capsular dehiscence correlates strongly with post surgical posterior component dislocation [1].

Surgical repair of the posterior capsule has been demonstrated to reduce dislocation rates following posterior approach THA; however, there is a paucity of research on the ability to evaluate posterior capsule repair integrity in the postoperative period [2].

Background

Posterior Approach THA
Posterior approach THA is also known as the Southern or Moore Approach, as it was initially described by Dr. A.T. Moore and Dr. Alexander Gibson in 1950. It is the most popular THA technique used today (45% World Wide and 69% North America) [3].

Description of the surgical technique is detailed below [4]:

- **Positioning**: Patient is placed in lateral decubitus position. The involved limb is draped freely to facilitate dislocating the hip and to permit maneuverability of the limb during the procedure.
- **Skin Incision**: Begins 5 cm distal to the greater trochanter centered on the femoral diaphysis. The incision continues proximal to the greater trochanter where it is then curved towards the posterior superior iliac spine for another 6 cm. *(Fig. 1 on page 9)*

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**Background- Posterior Approach**

**THA Surgical Technique**

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A. Skin incision before total hip arthroplasty.

B. Exposure of femoral head and neck after posterior joint capsule incision from its greater trochanteric attachment.


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**Fig. 1**: Posterior approach THA surgical technique. Skin and soft tissues.


- **Soft Tissue:**
Deep fascia overlying the gluteus maximus is incised and the gluteus muscle is split in line with the fibers down to the short external rotators. A deep retractor is used to retract the fascia and gluteus muscle. At this point internal rotation of the hip will allow for easy teasing of the fat surrounding the sciatic nerve to minimize risk of damage.

The piriformis is identified as the only taught, firm, band like structure with the hip internally rotated. It is released from its insertion point leaving a small cuff for reattachment. The piriformis tendon is reflected posteriorly.

The superior/inferior gemelli and the obturator internus are also identified and severed at their insertion. These are also reflected posteriorly further protecting the sciatic nerve.

The posterior joint capsule is then incised from its greater trochanteric attachment to reveal the femoral neck and head. (Fig. 1 on page 9)

- **Dislocation**: The femoral head is dislocated by internally rotating the hip. It may be necessary to perform an in situ osteotomy of the femoral neck before dislocation in patients with ankylosis of the hip joint, heterotopic bone, etc. This prevents undue stress on the femoral shaft and possible fracture.

- **Osteotomy**: A femoral neck osteotomy is performed using Hohmann retractors anteriorly and posteriorly to protect soft tissue. At this point access is gained to the acetabulum and proximal femur.

- **Reconstruction**:

  - Placement of Hohmann retractors around the acetabulum permits adequate exposure for reconstruction. Acetabulum can then be prepared with hemispherical reamers. (Fig. 2 on page 9)

  - Femoral preparation is done with the leg internally rotated, flexed and slightly adducted. This results in the lower leg being perpendicular to the ground. In this position there is easy visualization of the femur for unhindered placement of the stem and provides an accurate check for femoral anteversion.
Fig. 2: Posterior approach THA surgical technique. Reconstruction.


Posterior capsular repair technique: Soft Tissue Repair [2,4]

Repair of the posterior capsule and the short external rotators is imperative to postoperative success. At our institution closure of the posterior capsule is done using a 2.3-mm drill and #2 Ethibond suture (Ethicon, Belgium).

Three small holes are made approximately 1 cm apart over the greater trochanter using the 2.3mm drill bit. The entry point of the drill bit is placed so that the exiting drill bit is in the piriformis fossa, which usually is the junction between the posterior one third and middle one third of the trochanter width in the anteroposterior plane. The first stitch is placed at the apex of the inverted L or piriformis muscle tendon and capsule in a double loop. (Fig. 3 on page 10)
A running suture technique is used to repair the obturator internus tendon and capsule as well as the quadratus muscle to the posterior aspect of the muscle.

**Fig. 3**: Posterior capsular repair technique. References: A) University of Miami Miller School of Medicine. B) "Posterior Approaches to the Hip." Surgery of the Hip, by Bryan P. Springer, Saunders, 2013, pp. 249-256.


**Benefits of posterior approach THA [5]**

Posterior approach THA spares the hip abductor muscles during surgical exposure of the acetabulum and femur. This reduces the risk for abductor insufficiency, which can be observed postoperatively in up to 20% of patients undergoing THA using the direct lateral approach.
It also provides extensive exposure to the femur and acetabulum as required. This is particularly important in the management of patient cases with complex acetabular or femoral bone defects, revision surgery, surgery for pathological lesions of the proximal femur/acetabulum, or intraoperative complications such as fracture. Further extension of the posterior approach distally on the femoral shaft does not require stripping of the vastus lateralis.

Disadvantages of posterior approach THA [5]

- **Dislocation**: Incidence of dislocation following THA using the posterior approach is reported to be anywhere from 1-5% in the literature. The relative risk for dislocation is 8 times greater when soft tissue repair is not performed.
- **Sciatic nerve injury**: Given the anatomical location of this approach there is an increased risk for sciatic nerve palsy reported to be 1.3% in a review of 3000 THAs. In most patients, sensory and motor deficits resolved spontaneously.
- **Longer Recovery Time**: Posterior approach THA patients spend an average of 3.02 days in the hospital postoperatively compared to 2.28 days for those undergoing the anterior approach. This is likely due to the damage caused to the short external rotators through the posterior approach.

Benefits of posterior capsular repair [6]

Early dislocation is the main concern with posterior approach THA. Reasons for early dislocation include:

- Lack of patient compliance
- Inadequate capsular support
- Abductor laxity
- Bone or prosthesis impingement or both
- Off- set mismatch
- Component malposition

Formal posterior capsular repair can reduce risk of early posterior dislocation. It has been described 4.8% incidence of dislocation (n = 1078) in patients with posterior capsulectomy without capsular repair. However, incidence of dislocation in patients with posterior capsulectomy with capsular repair is 0.7% (n = 437).

Disadvantages of posterior capsular repair [6]
Main disadvantage of posterior capsular repair is increased risk of avulsion fracture. Capsular repair group showed an avulsion fracture of the greater trochanter in four of 437 total hip replacements (0.9%).
Background- Posterior Approach
THA Surgical Technique

A. Skin incision before total hip arthroplasty.

B. Exposure of femoral head and neck after posterior joint capsule incision from its greater trochanteric attachment.


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Fig. 1: Posterior approach THA surgical technique. Skin and soft tissues.

Fig. 2: Posterior approach THA surgical technique. Reconstruction.

Fig. 3: Posterior capsular repair technique. References: A) University of Miami Miller School of Medicine. B) "Posterior Approaches to the Hip." Surgery of the Hip, by Bryan P. Springer, Saunders, 2013, pp. 249-256.

Methods and Materials

Institutional review board (IRB) approval was granted to perform a retrospective chart review of patients from 2013-2018. (Total number of chart reviewed 675).

A list of all patients from our institution who underwent THA and who received magnetic resonance image (MRI) studies of the hip after the date of their surgery was obtained. (57 patients- 34 females [ages 37-79 years], and 23 males [ages 34-82].

Only symptomatic subjects with post-operative hip pain, locking, or perceived instability underwent post-operative MRI evaluation.

This list was further filtered through a review of operative notes to identify those patients who underwent posterior approach THA with a posterior capsular repair. (31 patients- 16 females [ages 37-78 years], and 15 males [ages 34-80].

Each MRI was interpreted by a fellowship-trained musculoskeletal radiologist with 15 years of experience for signs of posterior capsular dehiscence. If posterior capsular dehiscence was diagnosed, tear location was described (tear at the lateral margin, tear at the central third of the posterior capsule or tear at the medial margin).

All MRI's were performed using metal artifact reduction sequence (MARS) technique.

Each chart was evaluated for episodes of component dislocation.

Component dislocation was correlated with the MRI diagnosis of posterior capsule dehiscence.

Differences in dislocation rate between groups (those patients with MRIs demonstrating signs of dehiscence versus those without) was considered significant at p < 0.05.

MRI metal artifact reduction sequence (MARS) technique [1]

(Fig. 4 on page 15, Fig. 5 on page 15)

- Imaging at 1.5 T
- Fast spin-echo (SE) sequences
• High receiver (readout) bandwidth
• Thin sections
• Use of intermediate echo time (fluid-sensitive images)
• Large matrix in the frequency direction (eg, 512)
• High number of excitations
• Inversion-recovery fat suppression, instead of frequency-selective fat suppression

**MARS MRI of THA with intact posterior capsular repair**

**Fig. 4**: MARS MRI of THA with intact posterior capsular repair.

**References**: University of Miami Miller School of Medicine
Fig. 5: MARS MRI of chronic posterior capsular dehiscence.

References: University of Miami Miller School of Medicine
Fig. 4: MARS MRI of THA with intact posterior capsular repair.

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Fig. 5: MARS MRI of chronic posterior capsular dehiscence.

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Results

Results (Fig. 6 on page 20) (Examples: Fig. 7 on page 20, Fig. 8 on page 21, Fig. 9 on page 22, Fig. 10 on page 23)

- 32 symptomatic subjects after THA with Posterior Capsular Repair
  - 15/32 (48.4%) developed posterior capsular dehiscence after repair
  - 2/32 (6.3%) developed posterior hip dislocations
  - 2/15 (13.3%) of dehiscent capsules dislocated posteriorly
  - None of the subjects with intact capsules had posterior dislocation

Fig. 6: Results. Posterior capsular repair and hip dislocation.

References: University of Miami Miller School of Medicine
Results: Hip effusion

- 18/32 (56.25%) developed hip effusions
  - 12/18 (66.7%) had posterior capsular dehiscence
  - 6/18 (33.3%) had intact capsules
  - All subjects with posterior dislocations had concomitant hip effusion

Results: Tear Location

- 15/32 subjects had posterior capsular tears
  - 12/15 (80%) failed/tore at the lateral margin (greater trochanteric repair site) (Examples Fig. 12 on page 25, Fig. 13 on page 26, Fig. 14 on page 27, Fig. 15 on page 28)
  *Only subjects with lateral margin/greater trochanteric tears had posterior dislocations
  *Subjects with tears at the lateral margin/greater trochanteric attached demonstrated larger effusions than those with tears at other locations
  - 2/15 (13.3%) failed/tore at the central third of the posterior capsule (Examples Fig. 16 on page 29, Fig. 17 on page 30)
  - 1/15 (6.6%) failed/tore at the medial/acetabular margin (Examples Fig. 18 on page 31, Fig. 19 on page 32)
Fig. 11: Results: Tear location.

References: University of Miami Miller School of Medicine
Results

32 posterior approach THA Hip MRI’s with posterior capsular repair and post operative hip pain

17 intact posterior capsular repairs

- No confirmed dislocation

15 posterior capsular dehiscence

- 2 Number of confirmed posterior dislocations
- 13 Number of no confirmed dislocations

Fig. 6: Results. Posterior capsular repair and hip dislocation.

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Posterior capsular dehiscence in a patient with documented post-operative posterior hip dislocation.

Fig. 7: Axial proton density (A) and axial stir (B) MR images of a left hip arthroplasty showing torn posterior capsular repair (red arrows).

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Fig. 7: Posterior capsular dehiscence in a patient with documented post-operative posterior hip dislocation.

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Fig. 8: Posterior hip dislocation following THA with posterior capsular dehiscence.

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Posterior capsular dehiscence from the greater trochanter at the repair site in a patient with documented post-operative posterior hip dislocation.

Fig. 9: Posterior capsular dehiscence from the greater trochanter at the repair site in a patient with documented posterior hip dislocation.

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Fig. 10: Posterior hip dislocation following THA with posterior capsular dehiscence.

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Results: Tear location

15 posterior capsular dehiscence

12 failed/tore at the lateral margin (greater trochanteric repair site) (80%)
2 failed/tore at the central third of the posterior capsule (13.3%)
1 failed/tore at the medial (acetabular) margin (6.6%)

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Fig. 11: Results: Tear location.

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Posterior capsular dehiscence
Examples

- Lateral margin tears at the greater trochanteric repair site (red arrows).

Fig. 12: Diagram showing posterior capsular dehiscence at the lateral margin.

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**Fig. 13**: Example of posterior capsular dehiscence from the greater trochanter at the repair site.

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Fig. 14: Example of posterior capsular dehiscence from the greater trochanter at the repair site.

MR images show posterior capsular and ischiofemoral ligament dehiscence at the lateral margin/greater trochanteric repair site following total right hip arthroplasty surgery from posterolateral approach.

Fig. 14: Example of posterior capsular dehiscence from the greater trochanter at the repair site.

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Fig: Axial proton density (A) and axial stir (B) MR images of a left hip arthroplasty showing torn posterior capsular repair from the greater trochanteric at the repair site (red arrows), as well as hip effusion.

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**Fig. 15:** Posterior capsular dehiscence from the greater trochanter at the repair site.

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Posterior capsular dehiscence

Examples

- Central third of the posterior capsule tear (red arrow).

Fig. 16: Diagram showing posterior capsular dehiscence at the central third of the capsule.

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Fig. 17: Chronic tear of the central third of posterior capsule.

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Posterior capsular dehiscence
Examples

- Tear at the medial (acetabular) margin of the posterior capsule (red arrow).

Fig. 18: Diagram showing posterior capsular tear at the medial margin.

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**Fig. 19**: Chronic tear of the posterior capsular dehiscence at the acetabular attachment.

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Conclusion

Discussion

Approximately half (48.4%) of the patients in our study showed posterior capsular dehiscence, but of those only a minority (13.3%) had posterior dislocation.

The majority of posterior capsular tears occurred at the greater trochanteric repair site/lateral margin.

Only subjects with posterior capsular dehiscence at the lateral margin/greater trochanteric repair site dislocated.

No dislocation events were noted in patients with intact capsules.

More than half of our patients (56.25%) had hip effusions. Of those, the majority (66.7%) had posterior capsular dehiscence, most commonly at the lateral margin/greater trochanteric repair site.

All subjects with posterior dislocations had concomitant hip effusions.

Conclusion

- MRI can effectively diagnosis posterior capsular dehiscence in symptomatic patients after posterior approach THA.
- Almost half of symptomatic patients following THA with the posterior approach will show posterior capsular dehiscence.
- Posterior capsular dehiscence at the lateral margin/greater trochanteric repair site, as well as hip effusions are risk factors for posterior dislocation in symptomatic patients.
- This offers the potential to identify those patients at high risk of component dislocation, a primary cause of poor outcomes, in order to assist surgeons in deciding to pursue prophylactic intervention to re-repair the posterior capsule.
Thank you for your attention!

- For questions or inquiries, Dr. Ane Ugarte Nuño can be contacted at ane.ugartenuno@gmail.com

**Fig. 20**: Conclusion.

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References
