The new piriformis-preserving MIS posterior STAR approach for THA

By

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Introduction

The perfect minimally invasive surgical (MIS) approach for primary Total Hip Arthroplasty (THA) must be muscle-sparing, straightforward, and uncomplicated, providing fast and painless recovery and excellent cosmetic results [1]. The ideal MIS approach should deliver excellent exposure to both acetabulum and femur, guarantee accurate implantation, minimize the need for unique instrumentation, and improve the likelihood of surgeons' reproducible outcomes [1]. Several MIS techniques have been proposed for THA and their main reported advantages are improved cosmetic outcomes, better early functional results, and reduced hospital stay. On the other hand, the obstructed intraoperative visualization of the acetabulum and proximal femur during the MIS procedure increases the risk of intraoperative complications like implant malposition, periprosthetic fracture, and increased soft-tissue trauma. In addition, the limited access to the acetabulum and femur necessitates offset-reamers and special instrumentation leading to inconsistent results among surgeons or inappropriate acetabular reaming or stem positioning [1].

In 2020 Tsiridis et al. reported a case-series describing an MIS posterior muscle-sparing technique preserving the iliotibial band, offering an excellent view of the acetabulum and proximal femur performed with standard instrumentation [2]. Since then, we modified the incision to meet the needs of a better cosmetic result and always preserve the piriformis (PF) tendon to improve functional outcomes and stability, refining the technique to improve access to the acetabulum and femur. This new STAR (Superior Transverse Atraumatic Replacement) approach represents a MIS posterior muscle-sparing technique preserving the iliotibial band and piriformis tendon, providing a favorable acetabular and proximal femoral view. It is performed with standard instrumentation, offering an excellent cosmetic outcome and improved functional outcomes. In this article we describe the new MIS for THA in more detail with some surgical tips and tricks.

Surgical technique

Position of the patient

The patient is placed in the lateral decubitus position. Standard positioners are placed on pubic symphysis and lower lumbar spine to support the patient and allow for the joint's maximum mobility in flexion, extension, internal and external rotation. The skin is prepared and draped reliably to allow so the whole gluteal area to be accessible.

Anatomical landmarks

The greater trochanter's tip and the femur's proximal shaft are palpated and drawn with the marker pen to indicate the anterior and posterior cortex. We aim to identify the piriformis fossa level, which lies approximately two to three centimetres below the greater trochanter's tip and towards the femur's posterior aspect. To determine this anatomical location, we divide the greater trochanter and proximal femoral area into halves. Then, we mark a point three centimetres below the trochanter's tip on the femur's midline, and at this level, we draw a perpendicular line. The crossing of the two lines indicates the starting point of our approach (Figure 1). The initial incision is directed 45 degrees posteriorly and upwards from the incision's starting point at the greater trochanter's posterosuperior corner (Figure 2). The STAR approach goes parallel to the muscle fibers of the gluteus maximus muscle. It is also in line with the skin's Langerhans lines, which presumably leads to better healing without excessive scarring.

Main steps- acetabular approach

The subcutaneous tissue is incised in line with the skin incision down to the fascia of the gluteus maximus. This fascia is incised sharply to allow the gluteus maximus muscle fibers' blunt division, preserving the iliotibial band. The fat around the hip capsule is pushed down to expose the short external rotators (SER) and sciatic nerve (Figure 3). Meticulous hemostasis is performed at this stage at the femoral insertion of SER. The primary vascular supply of the area comes from the medial circumflex femoral artery (MCFA) ascending along the inferior border of the obturator externus, crosses the middle of the quadratus femoris anteriorly, and then turns almost 90 degrees parallel to the posterior femoral neck leaving at the turning point a short trochanteric branch [3]. It then passes anteriorly to the SER's insertion and then crosses the interval between the PF and the upper border of the superior gemelli. It then anastomoses with a vertical branch of the inferior gluteal artery that descends over the PF, the latter branch usually acting as an indicator of the PF [3] (Figure 4).

The gluteus medius (GMed) is then identified, and a Langenbeck retractor is placed under the GMed to expose better the PF and gluteus minimus (GMin) muscles. The plane between PF and the other SER is identified; the PF is bluntly separated from the superior gemellus and obturator internus (OI) and retracted with a small retractor (Figure 5). The hip is then flexed and internally rotated to fully expose OI and gemelli tendons that are tenotomised close to their femoral insertion. These tendons are stripped off the posterior capsule, tagged with an Ethibond

suture, and retracted posteriorly to keep the sciatic nerve safe (Figure 6). Obturator externus and quadratus femoris remain intact. The capsule is then exposed and incised from distally starting at the lower border of the posterior neck, parallel to the intertrochanteric line and up towards the PF fossa. It then crosses vertically down to the posterior acetabular rim in line with the PF's inferior border, protected by a slim retractor (Figure 7). The capsular flap that is formed is tagged with a running Ethibond suture and pulled back(Figure 8).

The hip is then flexed and internally rotated; the hip is dislocated, and the femoral head is removed. The leg remains in adduction and internal rotation to give the surgeon access to the anterior neck osteophytes and anterior capsule. A curved retractor is placed over the anterior acetabular rim to retract the proximal femur anteriorly while the leg is flat on the table (Figure 9). The surgeon is then free to remove the anterior labrum and, if necessary, to pie crust the rectus femoris' reflected head. Access to the acetabulum is facilitated with a Hohmann retractor positioned beneath the transverse acetabular ligament (Figure 9). A small self-retainer is placed superoposteriorly to hold the PF above and the posterior capsular flap away during reaming (Figure 9). We used straight reamers and other instruments for cup preparation and implantation.

Femoral preparation

During femoral preparation, the hip is placed in flexion, adduction, and internal rotation. The assisting surgeon holds the knee flexion of 90° with the tibia vertical, exerting longitudinal force to the leg to adequately expose the femur (Figure 10). Two blunt Hohmann retractors are needed at this step; the first curved Hohmann is positioned under the anterior femoral neck to lift the femur and the second on the calcar to retract muscles away. This way, anteversion of the femoral neck and ante-torsion of the proximal femur can be readily appreciated as the distal femoral intercondylar axis can be directly visualized, especially to the vertical proximal tibia that is held straight up (Figure 11).

Tendinous-capsular flap repair

Once the definite components are implanted, the tendinous-capsular flap is repaired. The capsular flap is repositioned first, followed by the musculotendinous flap. Reposition is mediated with tagging sutures passing through a transosseous channel made in the greater trochanter and lower part of Gmed (Figure 12). The other layers are closed with running absorbable suture. No deep drain is used.

Discussion

This is a preliminary report of the STAR approach surgical technique. We believe that the STAR approach is a straightforward, fast, reproducible, uncomplicated approach that offers an excellent view to both the acetabulum and proximal femur, being useful even for hip dysplasia and overweighted or obese patients.

The STAR approach is a muscle-sparing technique preserving the tensor fasciae latae, PF, obturator externus, quadratus femoris, the glutei muscles, and particularly the femoral insertion of the GMed and GMin. It is easier to identify and protect the PF tendon through the STAR approach. The tendon is separated from the conjoined insertion (Gemelli and obturator internus) below and adjacent to the piriformis fossa and is lifted along with the GMed and GMin away from the surgical field.

STAR is an easy to perform approach, facilitating exposure to both the acetabulum and proximal femur. This approach offers a clear circumferential view of the acetabulum and easy access to the proximal femur for preparation and implant insertion. In addition, easy identification of neck anteversion and proximal femur antetorsion due to direct visualization of the distal femoral intercondylar axis allows very precise stem insertion and combined anteversion. Other advantages of the approach include the direct view and protection of the sciatic nerve, the absence of major arterial branches that may bleed except the relatively small MCFA that can be coagulated easily at the quadratus femoris proximal insertion. Besides, it remains away from the anterior and middle neurovascular bundle. During surgery, there is no need for unique instrumentation, offset reamers, special retraction, table, or radiographic assistance. The intraoperative adjustment of limb position is standard and reproducible.

The STAR approach's unobstructed view of the acetabulum and proximal femur guarantees excellent and reproducible component position. This beneficial access allowed us to use any design of the cup and stems with or without cement. STAR can be efficiently used for mild or moderate dysplasia and obese patients [4]. This approach can be extended towards the acetabular roof for reconstructing dysplastic hips and distally in the femur to perform subtrochanteric or derotational shortening osteotomy. Additional to dysplasia, it is a helpful and easier approach for complex primary and even revision procedures.

No major complications were recorded with the STAR approach. The easy identification of the sciatic nerve protects the nerve throughout the procedure and diminishes the risk of sciatic nerve damage. The risk of instability remains low due to preserving PF, obturator externus, and quadratus femoris and thoroughly repairing the posterior capsule and conjoint tendon back in their anatomical position. Furthermore, the accurate implantation due to excellent direct view of both the acetabulum and the femur, and the current use of larger heads up to 36mm when possible allow more stability. The easy assessment of the laxity of soft tissues and leg length discrepancy, as well as the evaluation of abductor muscle tension and offset, especially in dysplastic hips and with the PF intact, are also advantages of STAR. The risk of intraoperative fractures is low, mainly attributed to the effortless and beneficial access to femur

and acetabulum, the excellent implant position under direct vision, and straight instruments with absolute control of hammering force and power.

Summary

STAR approach is a novel and easy to perform, muscle-sparing mini-posterior approach offering an excellent view of both the acetabulum and proximal femur. This approach is fast, reproducible, and uncomplicated, being beneficial even for hip dysplasia and obese patients. STAR is also a tissue-friendly approach with minimal blood loss like other MIS posterior approaches. The absence of major arterial branches that may bleed and the beneficial hemorrhage control of branches of the MCFA may help in this direction. The wound complication rate of the STAR approach is limited.

References

1. Kenanidis E, Rigkos D, Paparoidamis G, Yfantis A, Gamie Z, Tsiridis E, et al. Surgical Approaches of the Hip. In: Tsiridis E. (editor) The Adult Hip - Master Case Series and Techniques. Springer, Cham.2018; 51-64. https://doi.org/10.1007/978-3-319-64177-5_2

2. Tsiridis E, Kenanidis E, Potoupnis M, Sayegh FE. Direct superior approach with standard instrumentation for total hip arthroplasty: safety and efficacy in a prospective 200-case series. Hip Int. 2020; 30:552-8. doi: 10.1177/1120700019843120

3. Zlotorowicz M, Czubak-Wrzosek M, Wrzosek P, Czubak J. The origin of the medial femoral circumflex artery, lateral femoral circumflex artery and obturator artery. Surg Radiol Anat. 2018; 40:515-20. doi: 10.1007/s00276-018-2012-6

4. Kenanidis E, Kakoulidis P, Tsiridis E, Atilla B, Bicanic G, Sulje Z, et al. Acetabular Dysplasia. In: Tsiridis E. (editor) The Adult Hip - Master Case Series and Techniques. Springer, Cham.2018;107-213 https://doi.org/10.1007/978-3-319-64177-5_5

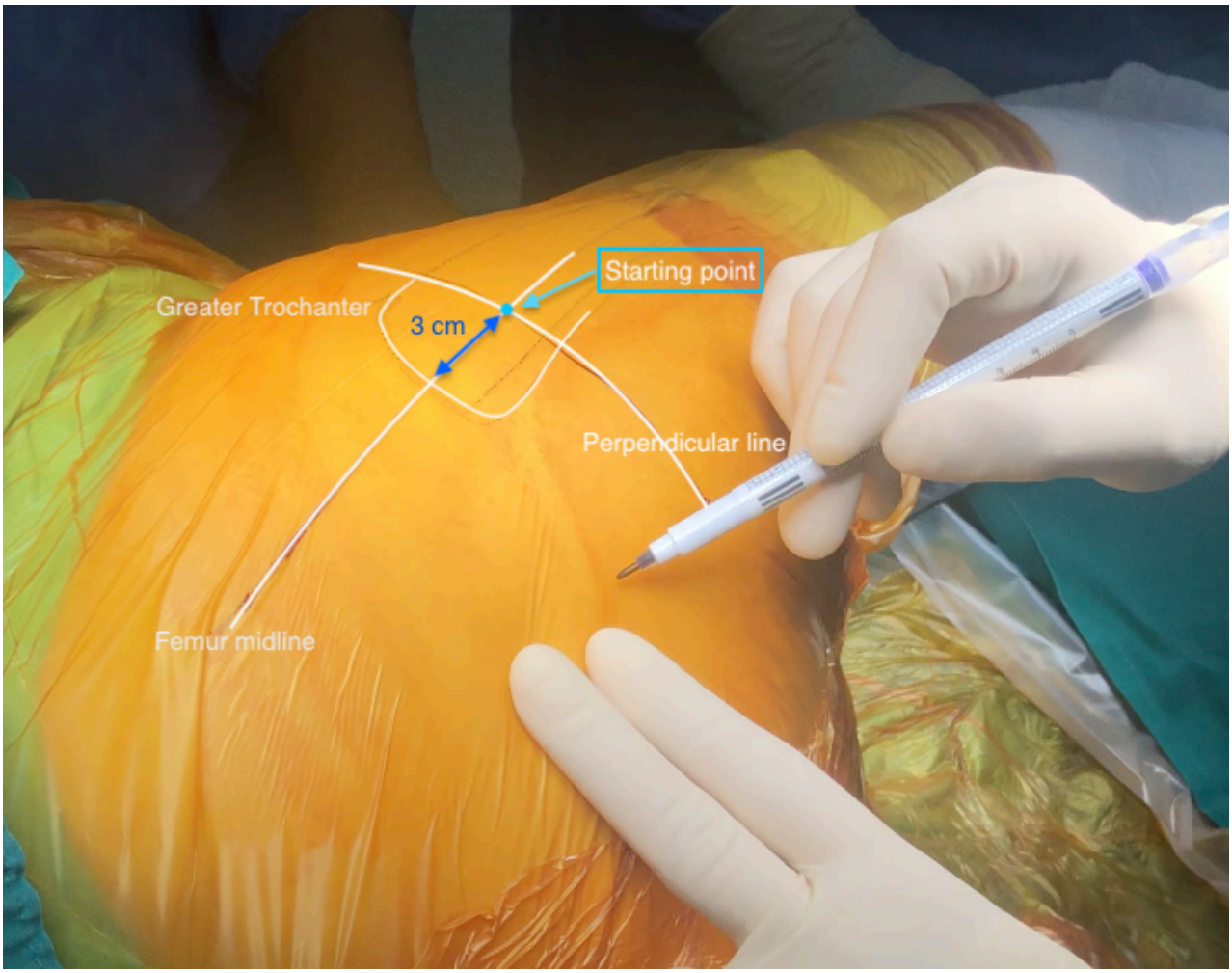

Figure 1: Starting point of the incision at the crossing of the femur's midline with a perpendicular line 3cm below the trochanter's tip.

Figure 2: Incision line from starting point, going 45° posteriorly and upwards of the perpendicular line.

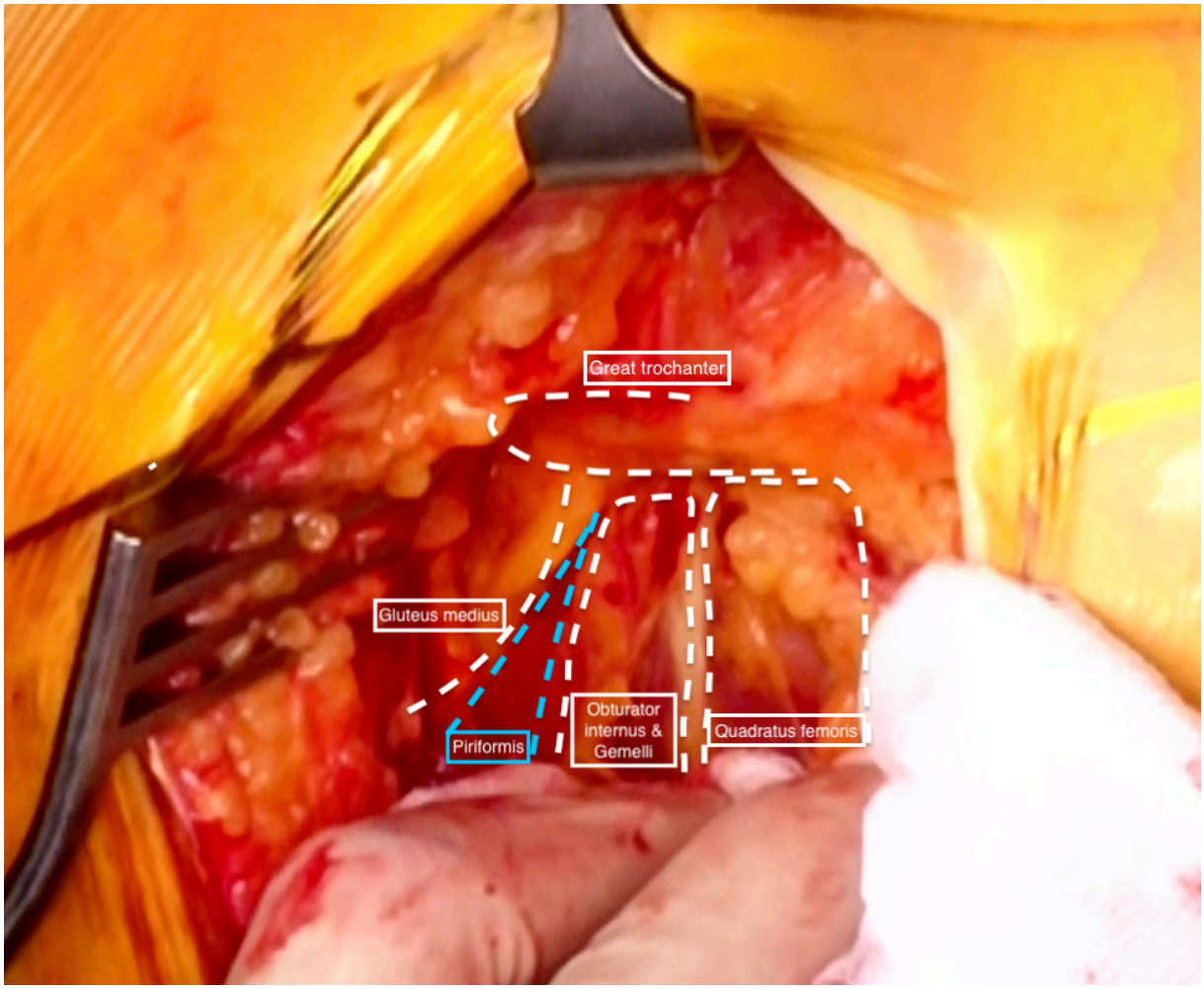

Figure 3: Exposed Gluteus Medius and Short external rotators

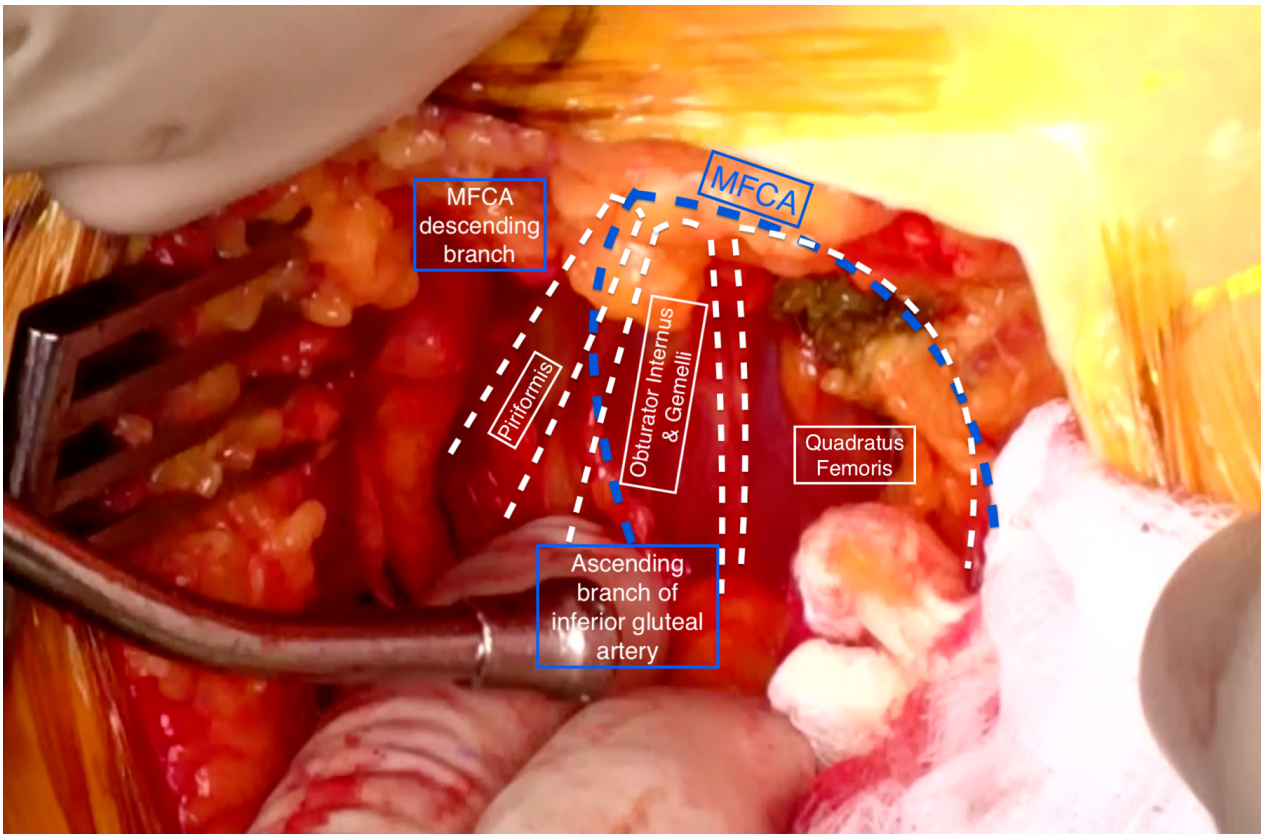

Figure 4: The assenting branch of inferior gluteal artery as an indicator of the Piriformis, with its anastomosis with the medial circumflex femoral artery.

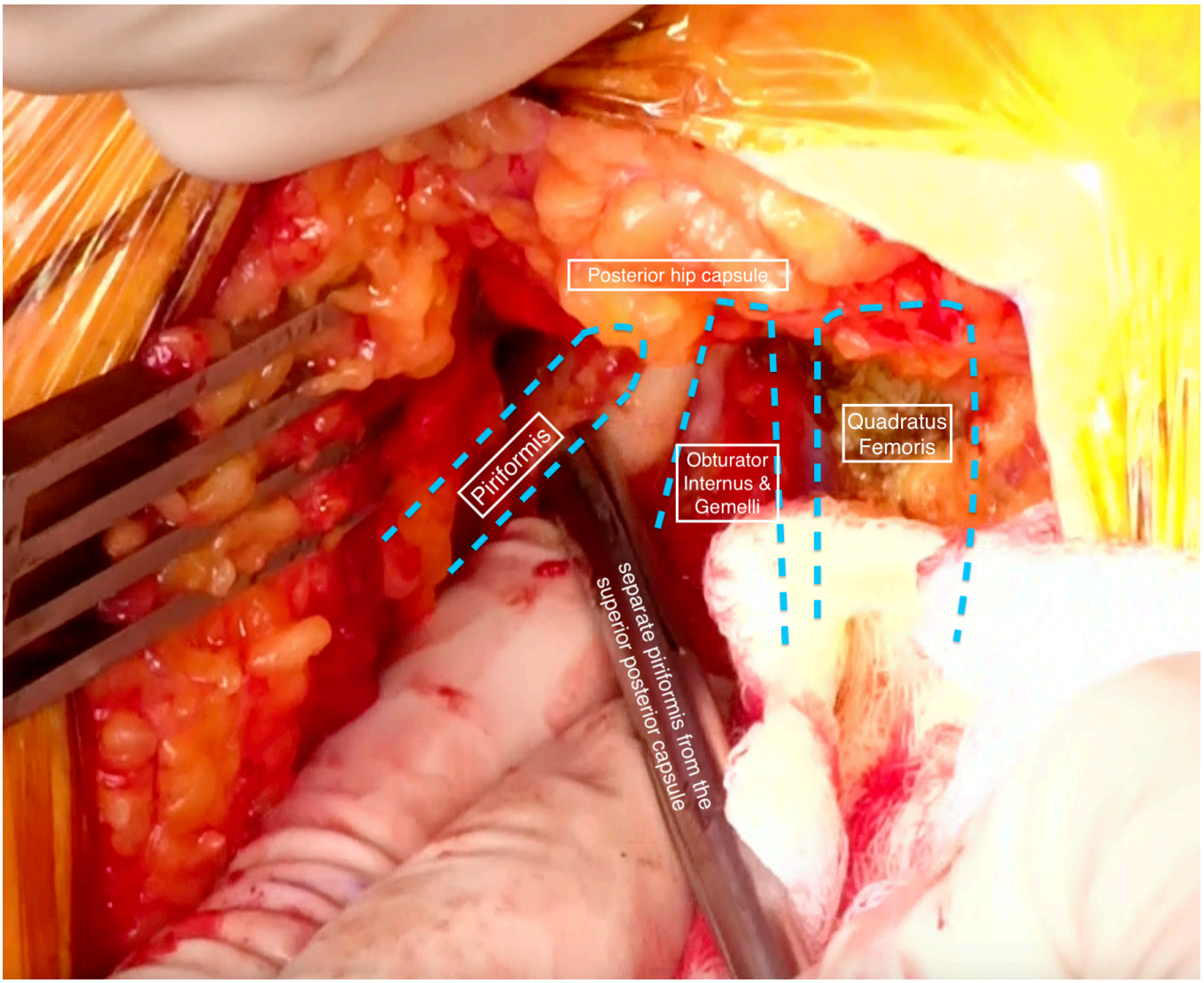

Figure 5: Separation of Piriformis from superior posterior capsule.

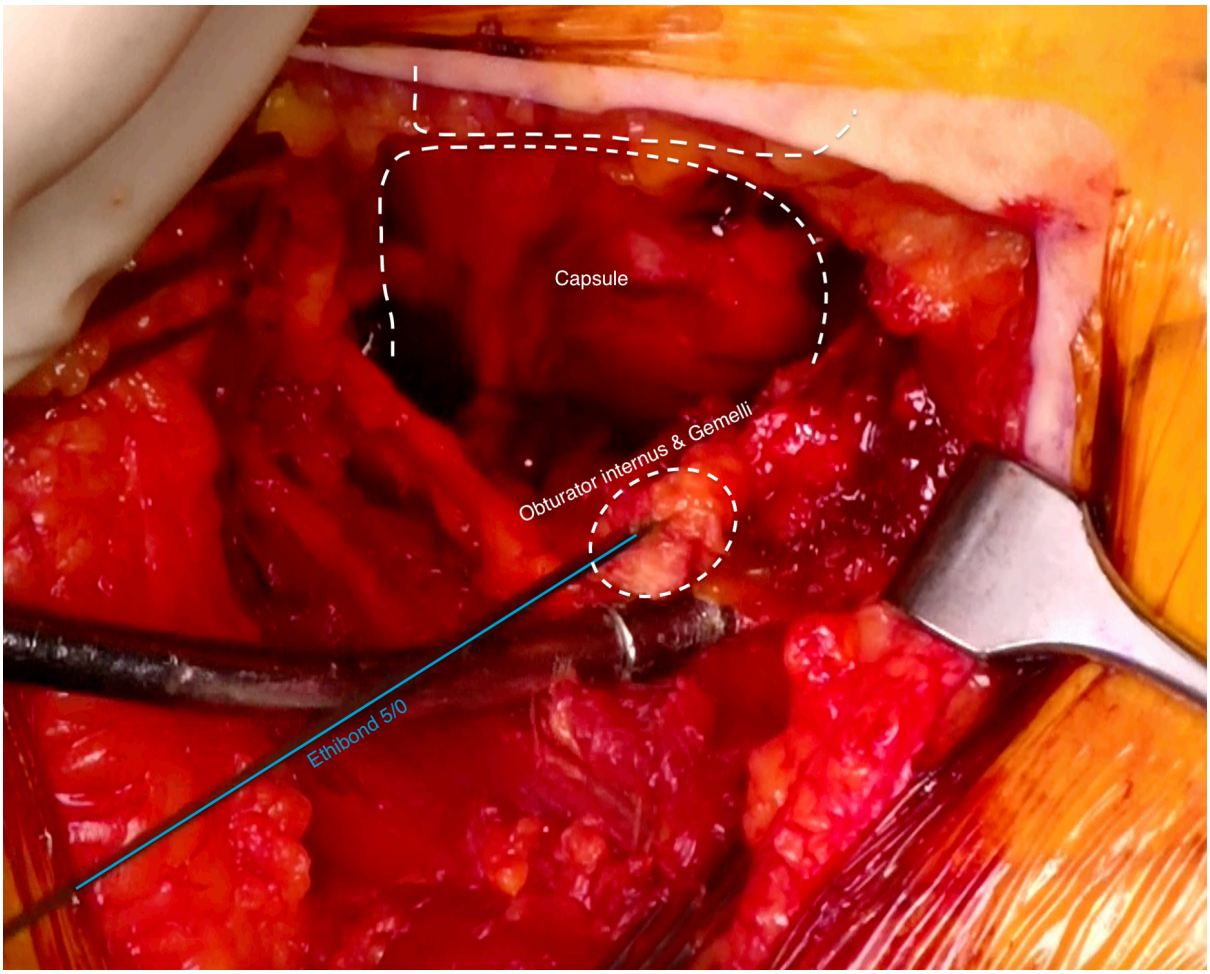

Figure 6: Obturator internus and Gemelli tenotomised and tagged with an Ethibond 5/0 suture

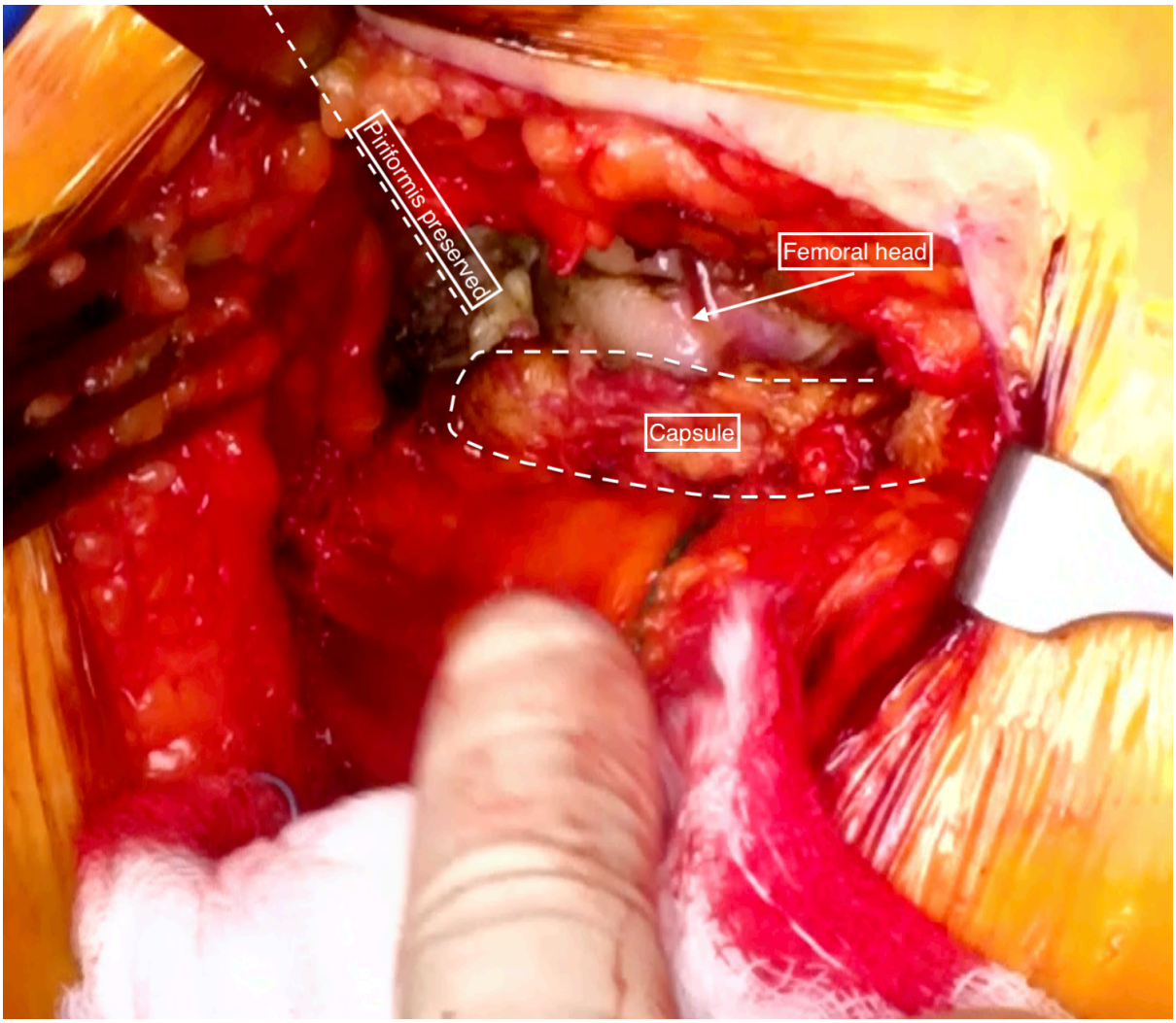

Figure 7: Incised capsule and exposed femoral head

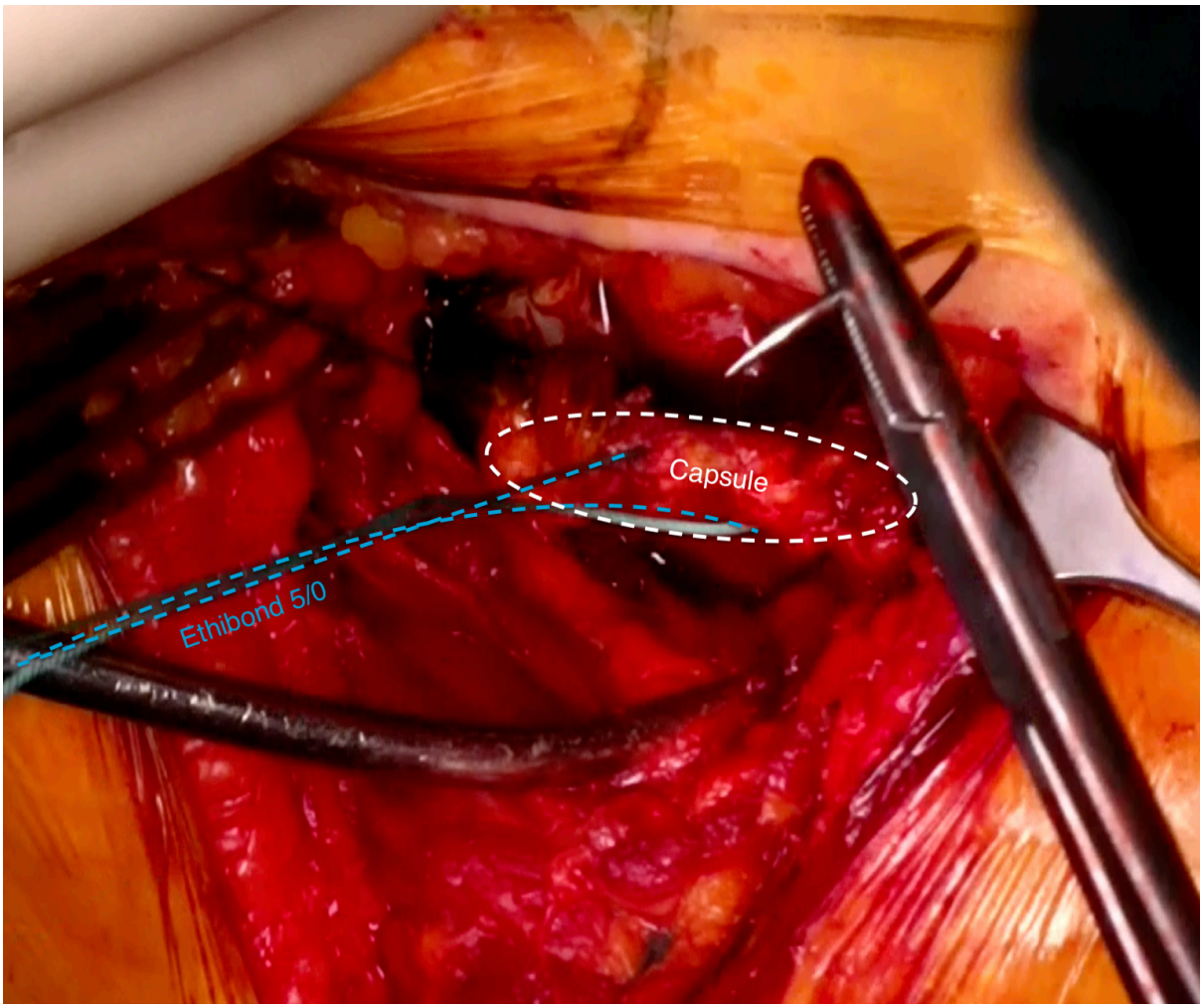

Figure 8: Tagged capsule with Ethibond 5/0 suture

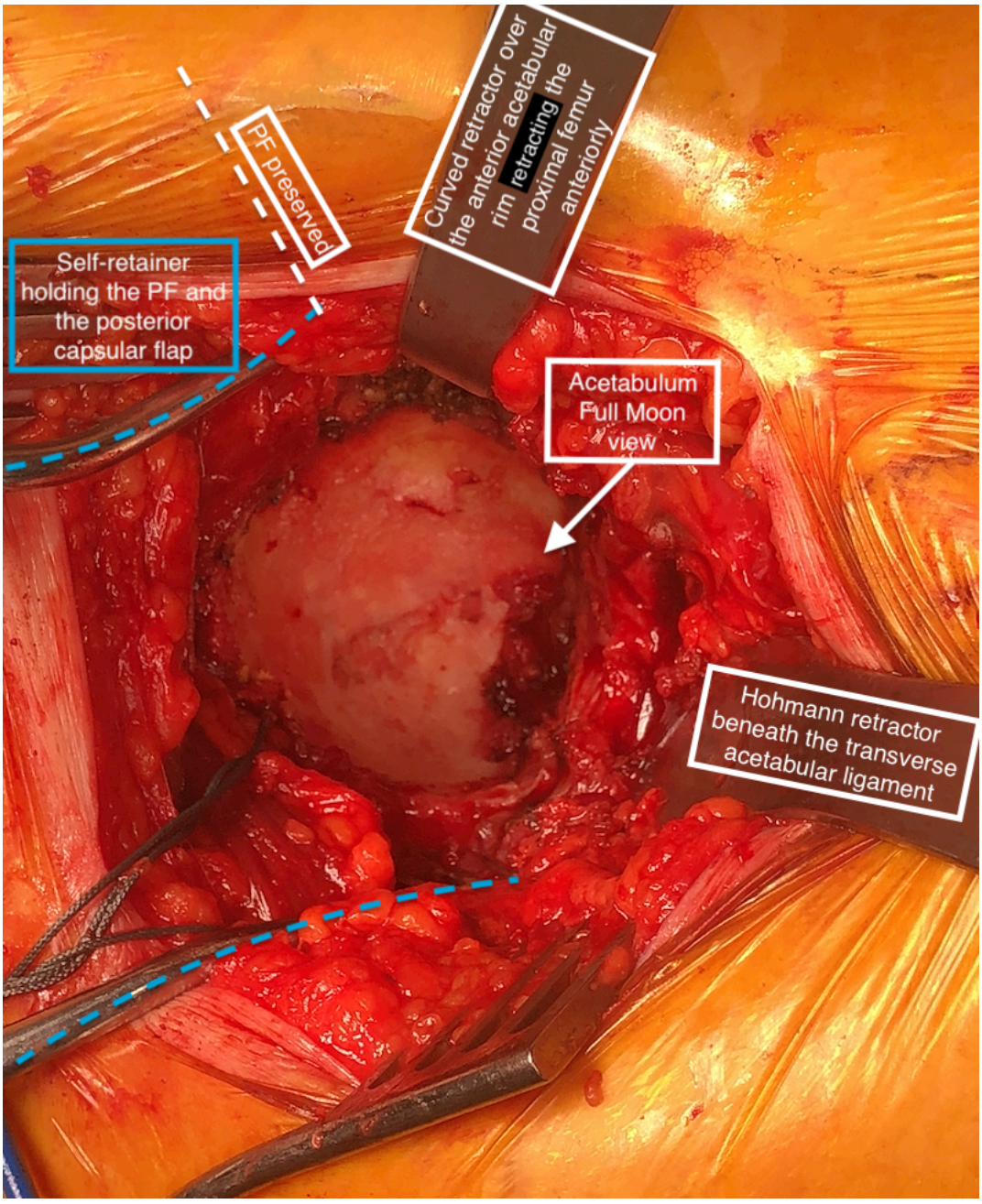

Figure 9: Acetabular "Full Moon" view with two Hohmann retractors and two self-retainers

Figure 10: Hip position during femoral preparation. Knee at 90º flexion, hip in adduction and internal rotation

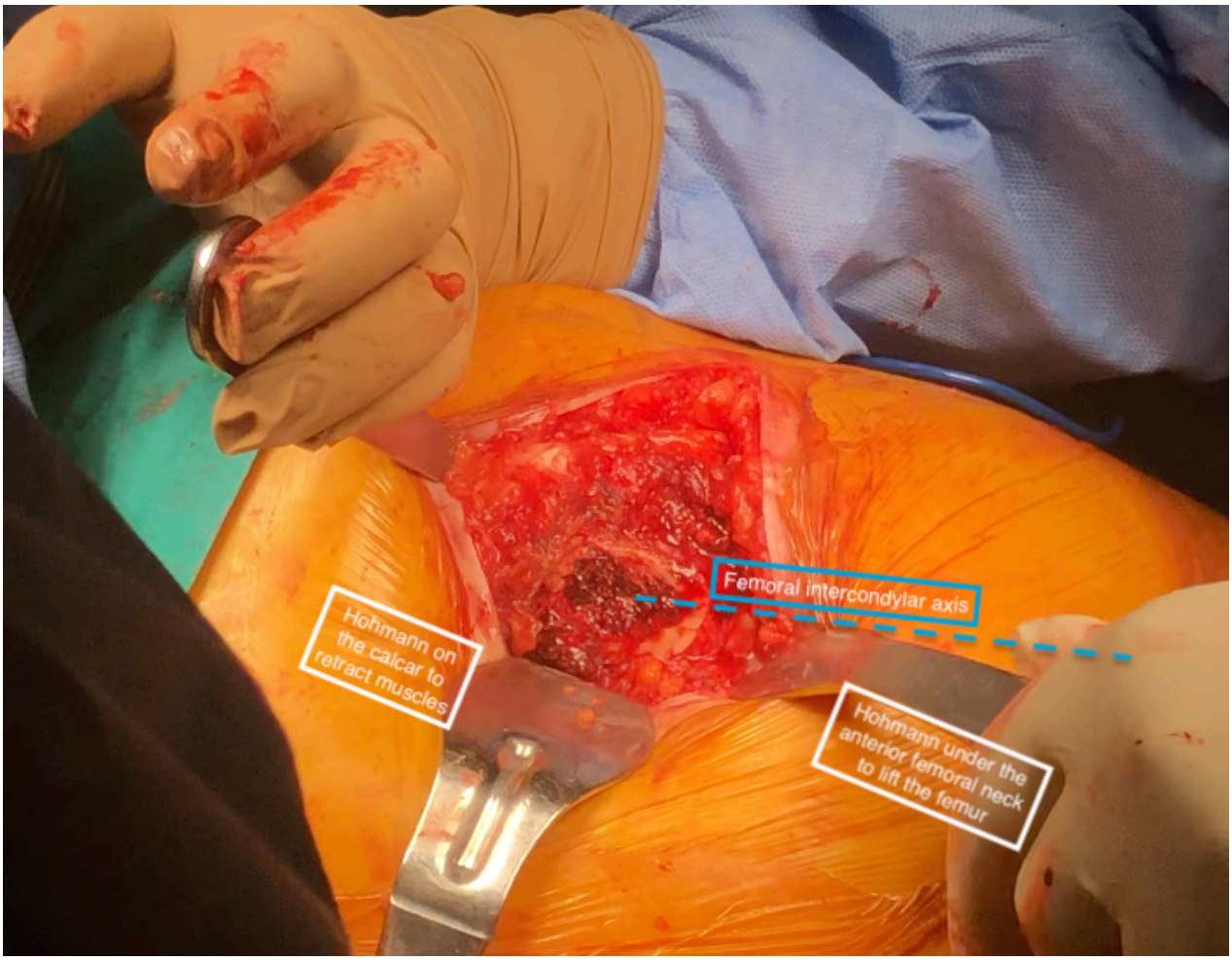

Figure 11: Two Hohmann retractors placed for direct visualization of the femoral intercondylar axis

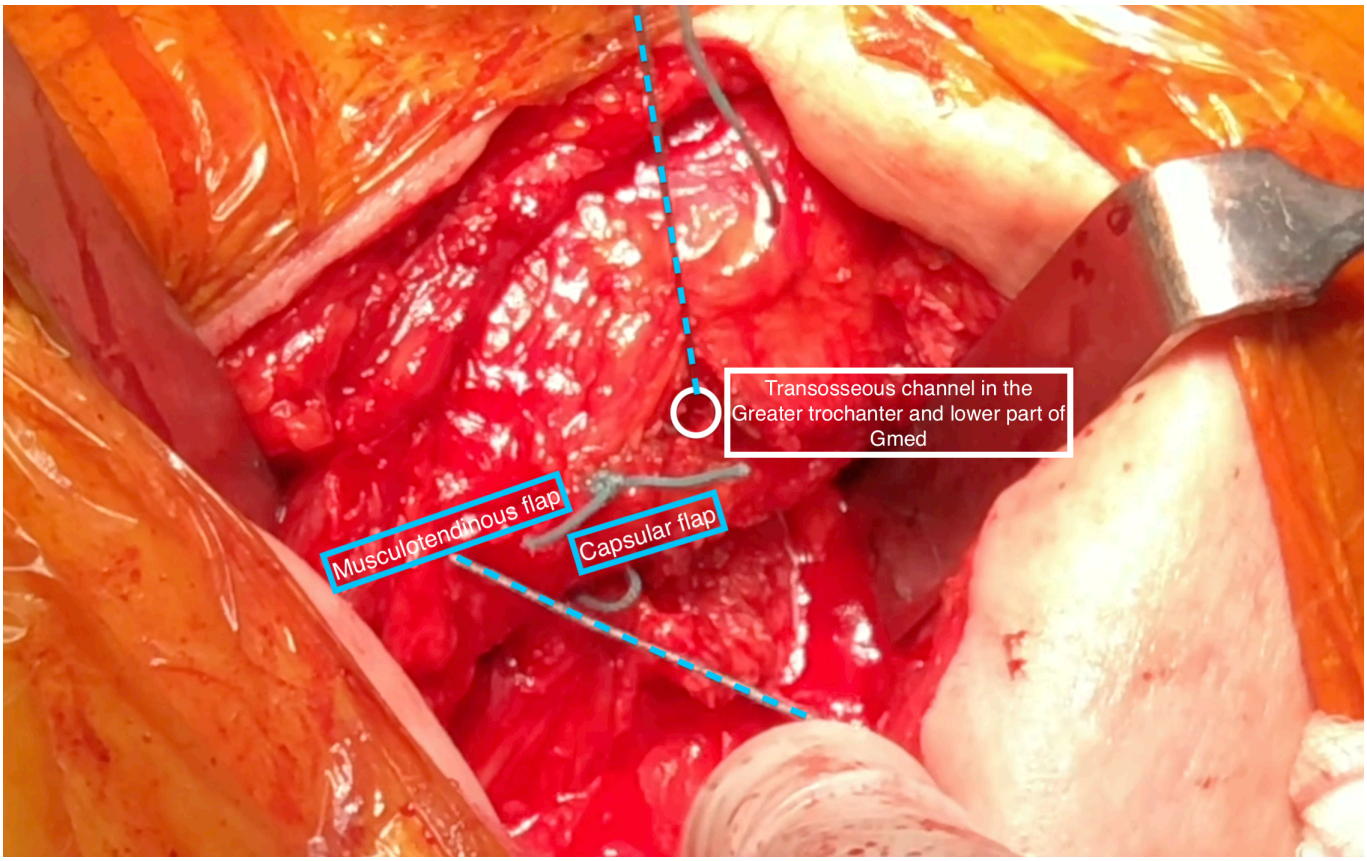

Figure 12: Tendinous-capsular flap repair with the tagging sutures passing through a transosseous channel in the greater trochanter and lower part of Gluteus medious