JBJS ESSENTIAL Surgical Techniques

Direct Anterior Total Hip Arthroplasty

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Based on an original article: *J Bone Joint Surg Am.* 2011;93:1392-8.

Introduction

In theory, the direct anterior approach offers the only path to performing minimally invasive total hip arthroplasty in an intermuscular, internervous plane.

Total hip arthroplasty can be safely performed through a number of surgical approaches. Recent interest in improving short-term outcomes has led to a focus on minimally invasive total hip arthroplasty. Classic approaches have been modified and include minimally invasive posterior, lateral, anterior, and two-incision surgical approaches. We present our preferred method of performing a direct anterior minimally invasive total hip arthroplasty.

We currently use the direct anterior surgical approach for the majority of total hip arthroplasties; we use another approach only if specific indications warrant it. We recently reported our results with this technique and compared them with those of a minimally invasive posterior approach[1]. We found lower levels of biochemical markers of muscle damage, immediately in the post-anesthesia-care unit and in terms of the cumulative rise over two days, compared with a posterior approach. These results lend some credence to the utility of our technique as a muscle-sparing approach.

The procedure is performed in six steps:

Step 1: Position and drape patient

Step 2: Superficial exposure

Step 3: Deep exposure

Step 4: Prepare acetabulum and implant acetabular component

Step 5: Prepare femur and implant femoral component

Step 6: Trial and close

Step 1: Position and Drape Patient

Careful positioning is necessary to complete this procedure on a standard operating room table.

- Reverse an electric operating room table so that the distal segment can be dropped to a 40° angle when it is time to broach the femur. Attach an arm-board to the contralateral side of the table so that the contralateral leg can be moved into abduction when the femur is prepared on the surgical side.
- Place the patient supine on the operating table with a 2-in (5-cm) foam pad or folded blankets under the sacrum. This allows the gluteal fat pad to hang posteriorly during the procedure. Position the patient so that the later table drop will be at the level of the patient's greater trochanter and the surgical side is flush with the edge of the bed to allow maximum room for positioning during femoral preparation (Fig. 1).
- Prepare the operative leg, leaving the contralateral leg free to be positioned under the drapes by an assistant (Fig. 2). This will be important during femoral preparation.
- Identify and mark the anterior superior iliac spine and the greater trochanter. Mark the top of the incision by making a point three fingerbreadths posterior to the anterior superior iliac spine. Draw the incision straight down the leg past the greater trochanter (Fig. 3). The usual incision length is 8 to 10 cm.

Step 2: Superficial Exposure

Incise the fascia overlying the tensor fasciae latae and lift up the anterior edge, avoiding the perforating vessels.

- After making the skin incision, identify the fascia overlying the tensor fasciae latae. You will usually be able to see the muscle belly and perforating vessels posteriorly through the fascia.
- Make an incision in the fascia in line with the skin incision (Fig. 4). Bluntly lift up the anterior edge of this fascia (Fig. 5).
- Bluntly develop the interval between the sartorius and the tensor fasciae latae and place deeper retractors between these muscle bellies. The lateral circumflex vessels are seen running lateral and perpendicular to the rectus

doi:10.2106/JBJS.ST.K.00015 2011, 1(3):e15

femoris muscle. These vessels must be identified and ligated before proceeding deeper (Fig. 6).

Step 3: Deep Exposure

The hip is flexed 30° during the deep dissection.

- Enter the deep interval along the side of the rectus femoris proximal to the greater trochanter. Curve this deep approach medially away from the anterior insertion of the abductor musculature onto the greater trochanter. Place a pointed Hohmann retractor inside the abductor musculature to rest on the superior aspect of the hip capsule between the greater trochanter and the superior aspect of the femoral neck. Lift up the knee, flexing the hip approximately 30° (Fig. 7); this will allow placement of a blunt Hohmann retractor against the medial aspect of the femoral neck (Fig. 8).
- Release the reflected head of the rectus femoris from the anterior aspect of the acetabulum (Fig. 9). After this release, place a wide pointed Hohmann retractor perpendicular to the inguinal ligament at the level of the released reflected head of the rectus femoris. Now place the knee flat on the table.
- Make a capsular incision from the intertrochanteric line to the anterior rim of the acetabulum (Fig. 10). Remove the superior portion of the capsule and expose the superior aspect of the femoral neck and the medial aspect of the greater trochanter ("the saddle"). Either excise or tag the inferior piece of capsule with sutures (Fig. 11).
- Replace the superior and inferior Hohmann retractors adjacent to the capsule. Make an osteotomy at the base of the femoral neck at the level of the so-called saddle at the base of the greater trochanter (Fig. 12). Make a second cut more proximally, at the level of the femoral head-neck junction (Fig. 13). Remove both osseous pieces with a 4.0-mm Schanz pin or a corkscrew device (Fig. 14).

Step 4: Prepare Acetabulum and Implant Acetabular Component

Ream the acetabulum in 10° to 15° of anteversion with an abduction angle of 40° to 45°.

- Place the superior and inferior acetabular retractors at the six o'clock position (the transverse acetabular ligament) and nine o'clock position in front of the transverse acetabular ligament. Keep the wide Hohmann retractor in the same place anteriorly. Remove any osteophytes, labrum, and foveal tissue. Make two or three "pie-crust" incisions in the posterior aspect of the capsule to increase mobility. Resect more of the femoral neck until the fold of the posterior aspect of the capsule is seen.
- Ream the acetabulum in 10° to 15° of anteversion with an abduction angle of 40° to 45° (Fig. 15). After reaming, insert the acetabular component and liner (Fig. 16).
- Remove all retractors and place the leg in a "figure of four" position. Release the medial aspect of the capsule until you can visualize the lesser trochanter. Place the leg back on the table flat and remove any remaining superior capsular tissue. Using a bone hook, pull up on the femur to assess the ability of the femoral neck to be brought up and away from the acetabulum. Release the superior aspect of the capsule and the piriformis tendon to facilitate exposure.

Step 5: Prepare Femur and Implant Femoral Component

Use offset broaches to access the femur and prevent perforation through the greater trochanter.

- With the femur mobilized, drop the end of the table 40° and adduct the operative leg with external rotation. The contralateral leg is placed on the arm-board in abduction.
- Place retractors to hold the femur in place and protect the soft tissues (Fig. 17). Open the femoral canal with offset reamers, rasps, and curets (Fig. 18). Use offset broaches to access the femur and prevent perforation through the greater trochanter (Fig. 19).
- Insert the femoral component.

Step 6: Trial and Close

Specifically check for impingement of bone on the implant with the hip flexed 90°.

- Evaluate the implant stability and leg lengths (Fig. 20). Specifically check for impingement of bone on the implant with flexion of the hip to 90° (Fig. 21). Check anterior stability with extension and external rotation. After satisfactory component placement is confirmed, close the wound in layers (Figs. 22 and 23).
- Use an abduction or standard pillow until the patient is fully awake and then remove it.

Results

This approach has been used successfully for total hip arthroplasty for decades[2]. Recently, interest in this exposure has increased as part of an emphasis on

minimally invasive total hip arthroplasty[3,4]. This approach offers the only way to access the hip for an arthroplasty procedure in a true internervous and intermuscular plane. This has been shown to improve early clinical parameters—especially timed walking and hip abductor muscle function—compared with traditional exposures[5,6].

This exposure does have a relatively steep learning curve, and complications have been reported[7-9]; these may be minimized by surgeon experience. The greatest difficulty encountered with this approach is mobilization and exposure of the femur. We stress the importance of an adequate capsular release with this technique. In cadaveric studies, this has improved exposure, especially with hip extension[10]. There should be no tension on the retractor elevating the femur during femoral canal preparation. The retractor should simply hold the femur in a position that was achieved after soft-tissue release.

Recently, we compared minimally invasive total hip arthroplasties done via the direct anterior approach with those done through a posterior exposure[1]. In this prospective analysis, we found lower rises in levels of markers of muscle damage with no difference in component placement. Specifically, creatine kinase levels in the post-anesthesia-care unit were more than five times higher following use of the posterior approach. When we combined values at different time points in the post-anesthesia-care unit and on the first two postoperative days, we found the overall rise following the direct anterior approach to be almost half that following the posterior exposure. There were trends for lower levels of markers of inflammation (C-reactive protein, tumor necrosis factor-alpha, interleukin-6, and interleukin-1 beta) in the anterior-approach group, but none were significant. This evidence points to the utility of the direct anterior approach as a muscle-sparing option without compromise of component placement.

What to Watch For

Indications

- Most patients can be treated with the direct anterior approach for placement of a total hip prosthesis.
- Typically, this technique is the most straightforward in female patients with a supple hip and few osteophytes.
- Hips with a low greater trochanter are typically easier to treat with this technique than hips with high offset.
- An extensile exposure can be utilized with this approach. The incision can be extended down the femur in either the Smith-Petersen or Watson-Jones interval (anterior or posterior to the tensor fasciae latae) for fractures or revisions. The tensor fasciae latae may also be partially released from its proximal origin to increase femoral exposure.

Contraindications

The contraindications for this procedure, which are the same as those for all total hip arthroplasties, include:

- Infection, sepsis, and osteomyelitis
- An uncooperative patient
- Neurological and cognitive disorders that prevent the patient from following instructions
- Vascular or neuromuscular disorders that preclude the patient from walking

Pitfalls & Challenges

- Take care to avoid any mechanical or pneumatic device to “pull up” the femur since this can lead to fractures of the greater trochanter. The retractors should “hold up” the femur after an adequate soft-tissue release has been performed.
- Femoral exposure can be difficult without a proper soft-tissue release. Generous excision of the superior aspect of the capsule facilitates exposure. Similarly, it may be necessary to release the piriformis tendon to increase exposure. Take care to ligate the vessels adjacent to the piriformis tendon when performing this procedure.
- Straight femoral stems should be avoided. Curved offset instruments are necessary to ensure proper placement of the femoral components. The best component is a curved stem with a “cut-down” greater trochanteric shoulder.
- Avoid overreaming of the anterior acetabular wall. It is best to use a smaller reamer first to encourage the proper anteversion before using a normal-size reamer.
- Avoid excessive acetabular cup anteversion. It is best to remove all posterior osteophytes as this will allow more precise implantation of the cup and also help mobilize the femur into the wound.

Clinical Comments

- What measures do you take to mobilize the femur with the direct anterior approach to prevent femoral fractures?
- What restrictions, if any, do you place on patients postoperatively?

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Disclosure: None of the authors received payments or services, either directly or indirectly (i.e., via his or her institution), from a third party in support of any aspect of this work. One or more of the authors, or his or her institution, has had a financial relationship, in the thirty-six months prior to submission of this work, with an entity in the biomedical arena that could be perceived to influence or have the potential to influence what is written in this work. No author has had any other relationships, or has engaged in any other activities, that could be perceived to influence or have the potential to influence what is written in this work. The complete **Disclosures of Potential Conflicts of Interest** submitted by authors are always provided with the online version of the article.

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Figures

Fig. 1 Patient positioning. Note how the patient's hip is at the break of the operating room table and the patient is near the operative side of the table.

Fig. 2 The patient prepared and draped. Only the operative leg is prepared, allowing the contralateral leg to be moved under the drapes by an assistant during femoral preparation.

Fig. 3 The incision drawn on the thigh. The anterior superior iliac spine and the greater trochanter are marked, and a longitudinal 10-cm incision is drawn three fingerbreadths lateral to the anterior superior iliac spine.

Fig. 4 The incision to the level of the gluteal fascia. At this level, you will be able to see the tensor fasciae latae musculature as well as perforating vessels in the lateral aspect of the wound.

Fig. 5 The fascia overlying the tensor fasciae latae is elevated anteriorly, avoiding the perforating vessels posteriorly and laterally.

Fig. 6 The lateral femoral circumflex vessels (arrow) running lateral to the rectus femoris muscle, adjacent to the tip of the hemostat. These vessels must be controlled before proceeding with the exposure.

Fig. 7 The hip is flexed 30° by the assistant during the deep dissection. This relaxes the hip flexors, allowing placement of the medial retractor.

Fig. 8 The exposure gained from hip flexion and placement of the medial acetabular retractor.

Fig. 9 The reflected head of the rectus femoris is released, and a ventral retractor is placed. This is done while the hip is still flexed 30°. After the retractor is placed, the knee may be placed back on the operating table.

Fig. 10 The surgeon incising the superior aspect of the capsule. Generous excision of the capsule is recommended to increase both acetabular exposure and femoral mobility later in the procedure.

Fig. 11 The surgeon placing a tag suture in the inferior-medial capsule flap.

Fig. 12 The surgeon making the first osteotomy at the base of the femoral neck to the saddle of the greater trochanter.

Fig. 13 Photograph showing the second cut as well, directly in the subcapital location. Having smaller femoral head pieces facilitates their removal through this approach.

Fig. 14 The femoral head fragments being removed with a 4.0-mm Schanz pin.

Fig. 15 The acetabular exposure gained with this approach. The acetabulum is first reamed with a small reamer to set the anteversion and prevent overreaming of the anterior wall.

Fig. 16 The acetabular component in place. Use of curved and offset instruments is helpful with this exposure.

Fig. 17 The femoral exposure gained by adducting and externally rotating the operative leg with the table dropped 40°. This allows hip extension and brings the femur into the operative field. Take care not to use retractors that force the femur into the wound. Soft-tissue releases must be performed to allow the femur to be gently brought into the wound.

Fig. 18 The curved canal finder is used to enter the femoral shaft. Curved and offset instruments are necessary to avoid injury to the greater trochanter.

Fig. 19 A broach with an offset handle is used to prepare the femur.

Fig. 20 The surgeon checks the leg lengths with the trial components in place.

Fig. 21 The surgeon checks the stability of the trial components, looking especially for impingement with hip flexion at 90°.

Fig. 22 The capsule being repaired.

Fig. 23 The gluteal fascia being closed.

Fig. 1

Fig. 2

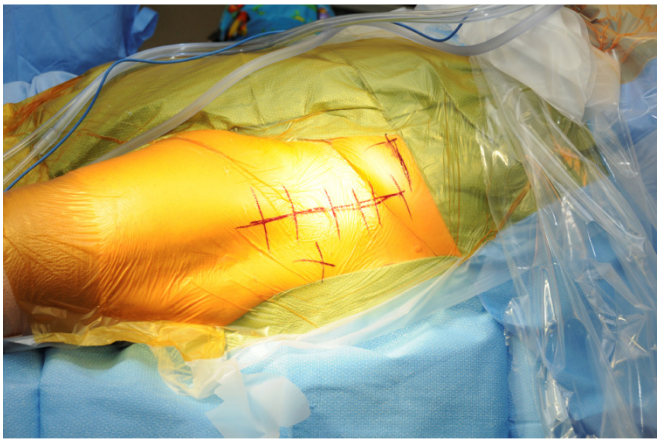
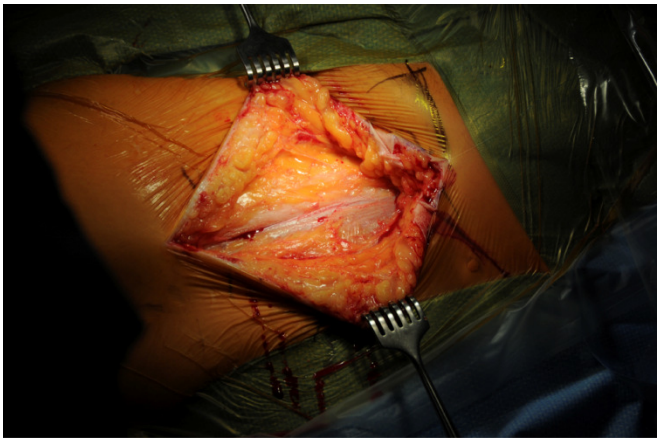


Fig. 3



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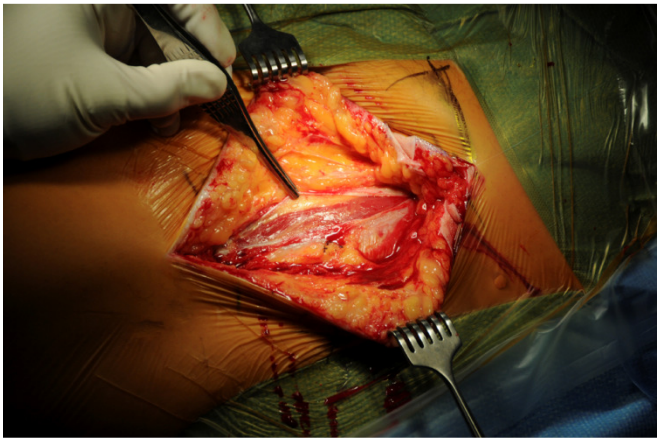

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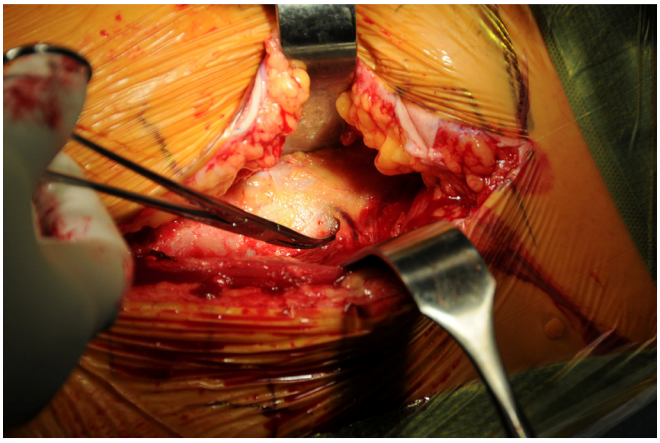

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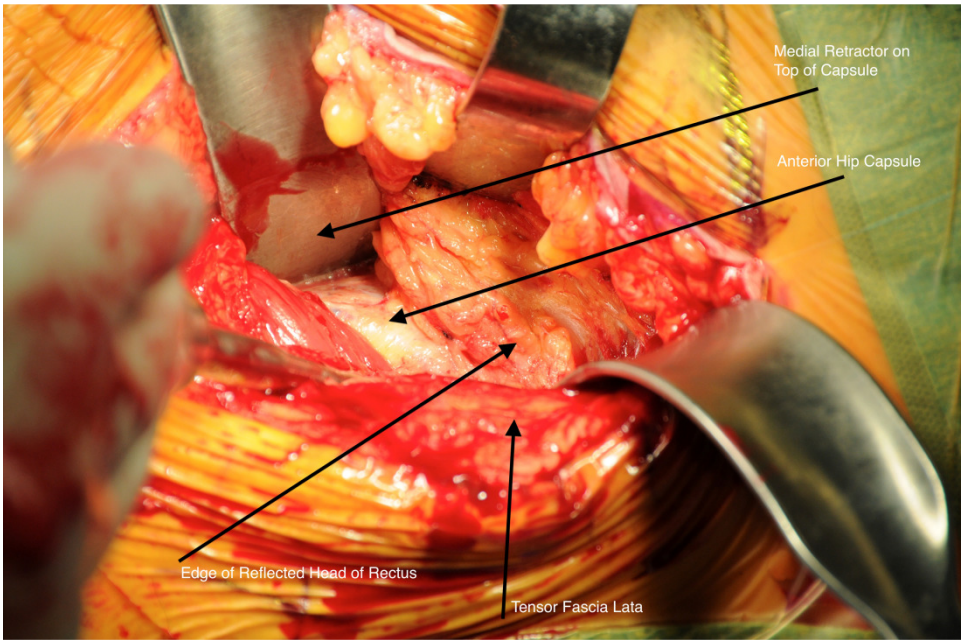
Fig. 7



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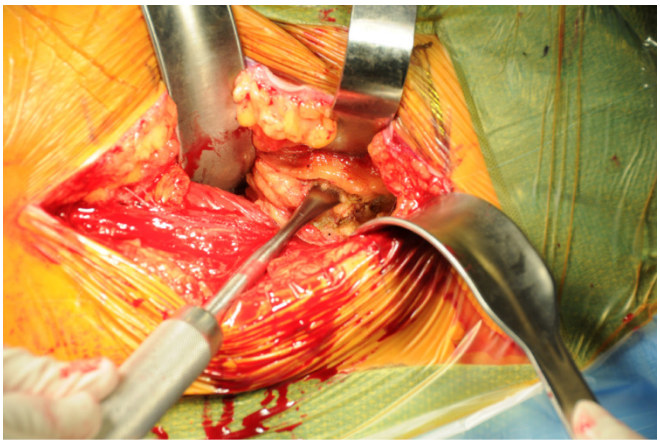

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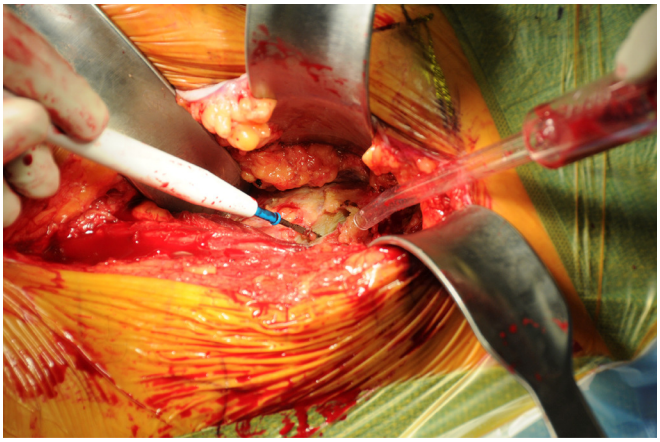

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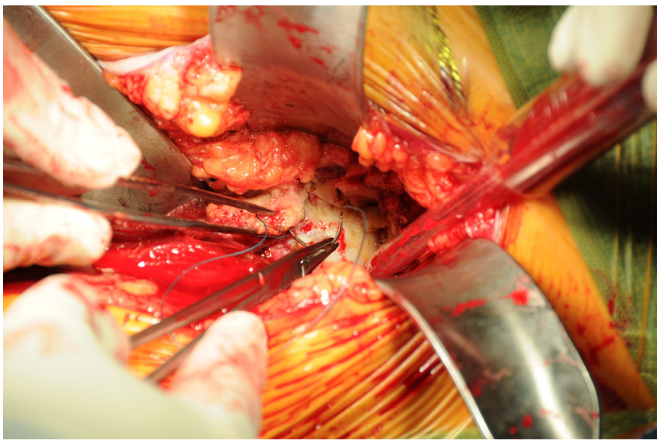

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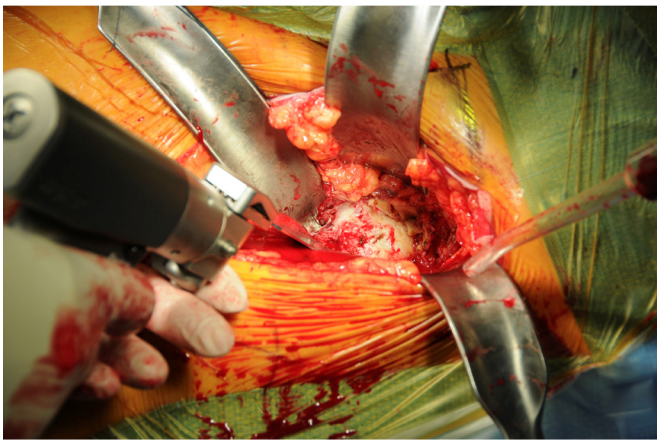

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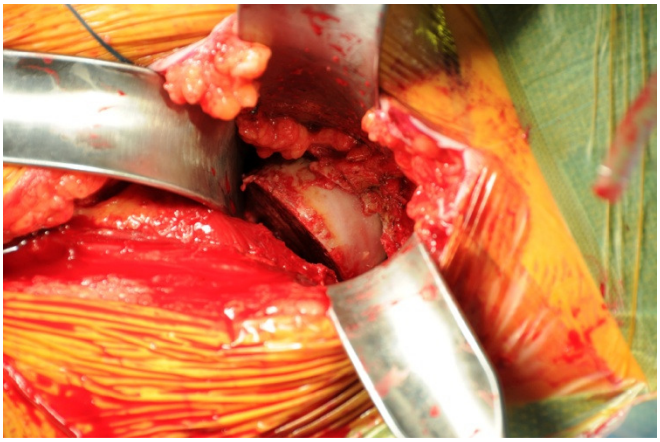

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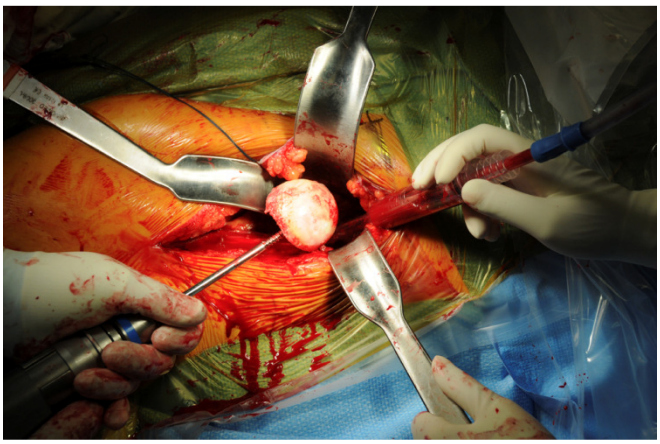

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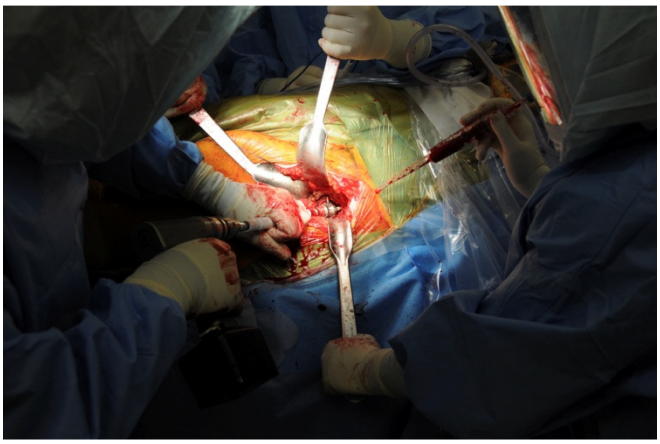

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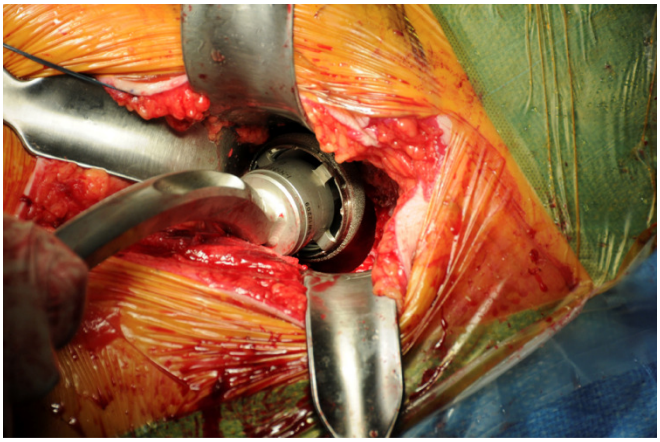

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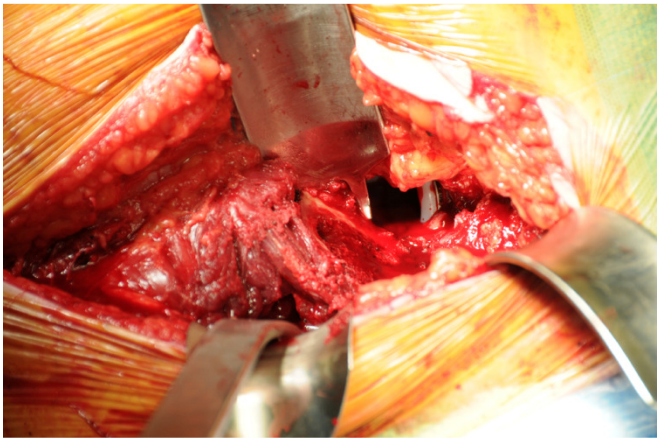

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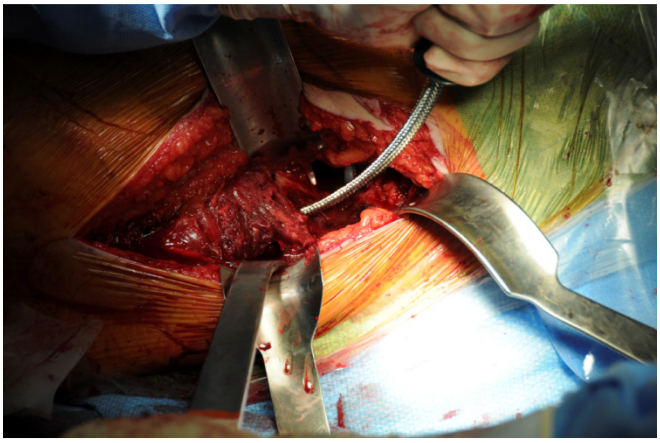

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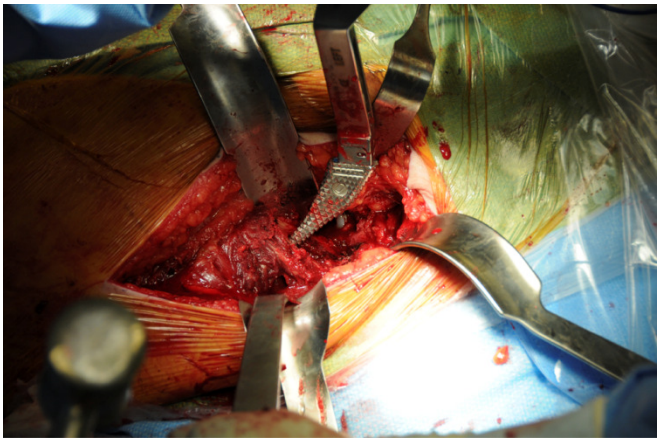

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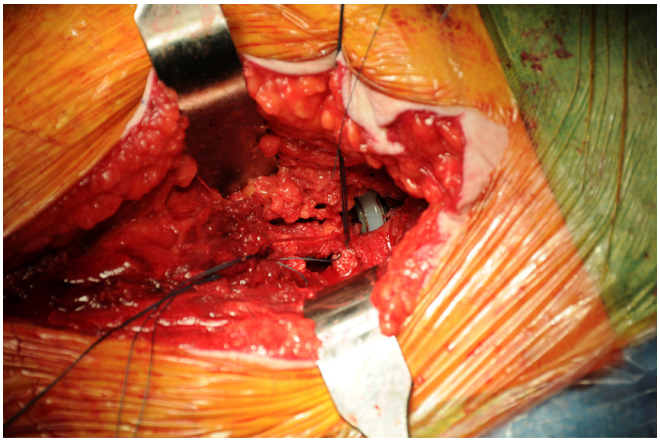
Fig. 20

Fig. 21



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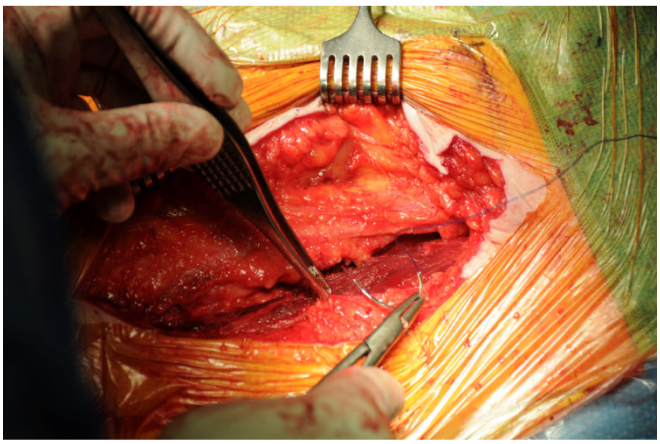

Fig. 23