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Introduction

Anterior Approach Philosophy

The Anterior Approach Surgical Technique for Total Hip Replacement is described by Joel Matta, M.D., who has brought the Anterior Approach technique as it is known today into the United States. This approach is an advanced application of the Heuter approach using the Hana® table from Mizuho OSI®. These tables help to streamline the technique, creating a reproducible procedure that minimizes soft-tissue releases and eliminates the need for secondary incisions to accommodate instrumentation or the femoral component. The technique does not cut any muscles, but separates them to allow access into the hip joint. The result is that muscles are spared during surgery. With these advantages, the Anterior Approach provides the potential for a quicker recovery compared to traditional hip replacement surgery.

Anterior Approach Revision Surgery

The Anterior Approach surgical technique as described by Joel Matta can also be done for revision surgeries. This technique allows for an extensive approach to the hip to be utilized during revision surgery. Surgeons may proximally or distally extend the traditional Anterior Approach incision to allow for improved exposure of both the acetabulum and femur, with the ability to extend up the iliac wing and down to the knee.

Hip revision surgery traditionally carries a higher risk of dislocation compared to the primary hip procedure. Anterior Approach Revision surgery can offer many of the benefits offered in the primary Anterior Approach procedure. Soft tissue releases are reduced and the posterior structures of the hip are largely kept intact which potentially improves the stability in revision surgery.

The reduction in soft tissue releases and intramuscular approach potentially reduce the recovery time of these difficult surgeries well. The ability to use fluoroscopy improves implant sizing and positioning while maintaining precise control of leg lengths and offset. Access to the inner table of the pelvis and anterior column is also possible through the extended Anterior Approach, which is not possible from other approaches to the hip. The Anterior Approach should be looked at as a viable option to revision hip arthroplasty. Its applications extend far beyond primary surgery and with proper training and experience it can be used for the majority of revision surgeries.

Anterior Approach Education Program

DePuy Synthes Joint Reconstruction has collaborated with Joel Matta, M.D., to build a comprehensive training and education program around the Anterior Approach. This program features Anterior Approach Courses offering hands-on cadaveric training, didactic lectures and interactive discussion. Surgical technique papers, surgical technique videos, specially designed Anterior Approach instrumentation, marketing materials, O.R. visitations, and field specialists further augment DePuy Synthes Joint Reconstruction’s comprehensive Anterior Approach program.

Anterior Approach Resources

Additional resources for surgeons, patients and OR Staff can be found at www.depuysynthes.com and www.depuysynthesinstitute.com including an interactive 3D animation for surgeon and OR staff education.

*The Hana® table is not a DePuy Synthes product, nor is it the only table that can be used for this approach. This surgical technique still applies when using other tables.
About the Authors

Joel Matta, M.D.
Dr. Joel Matta brought the Anterior Approach to the United States from Europe and has advanced the technique through training and education. The CORAIL® Total Hip System and the Anterior Approach surgical instruments were designed in conjunction with Dr. Matta and a team of other surgeons. Having performed over 4,000, Anterior Approach hip replacements, Dr. Matta has also been instrumental in the training of many orthopaedic surgeons in the technique, and serves as chairman of DePuy Synthes’ Anterior Approach Courses.

Dr. Matta is the co-founder and chairman of the Anterior Hip Foundation (AHF, www.anteriorhipfoundation.com) and currently specializes in hip and pelvis reconstruction at The Steadman Clinic in Vail, CO. Dr. Matta is also the author of over 100 publications and videos on hip replacement and pelvic surgery.

Dr. Matta is a consultant for DePuy Synthes, and receives royalties as the designer of the PROfx®, Hana® or Hana SSXT® tables which are manufactured by Mizuho OSI.

Charles A. DeCook, M.D.
Dr. Charles DeCook is dual boarded in orthopaedic surgery and family medicine and specializes in total hip and knee replacements. He is the Co-Founder and Vice-Chairman of the Anterior Hip Foundation. He has dedicated his career to the advancement of the Anterior Approach under the guidance of Dr. Matta. He has performed over 5,500 Anterior Approach total hip replacements and seeks to treat the patient as a whole to shorten recovery time after surgery. He believes the future of hip replacement will occur on an outpatient basis.

As a thought leader in total hip and knee replacement surgery, Dr. DeCook works with the industry, improving surgical techniques and designing implants and tools that aim to provide better patient outcomes. He has traveled both nationally and internationally to teach other surgeons and improve upon techniques for hip and knee replacements, and has served as a lecturer at some of the most esteemed symposiums in the world. He was recently recognized for his excellent care, being awarded the Leaders in Joint Replacement award by Orthopaedics Today.

Jonathan Yerasimides, M.D.
Dr. Yerasimides is an orthopaedic surgeon who specializes in surgery of the hip and pelvis. He attended the combined six year program at the University of Missouri–Kansas City where he earned his B.A. in Biology and later an M.D from the same institution. In 2005, Dr. Yerasimides completed his residency in orthopaedic surgery at the University of Louisville. His interest in hip and pelvis surgery motivated him to look for a subspecialty fellowship in this area. This interest led him to the foremost authority on surgery of the hip and pelvis in the United States, Dr. Joel Matta. Dr. Yerasimides interviewed with Dr. Matta in Los Angeles for his single fellowship position and was accepted for the 2005-2006 fellowship year.

With over 900 cases completed, he exclusively operates on the hip and pelvis and has performed over 5,500 Anterior Approach hip replacements since August of 2006. He is considered a top authority on Anterior Approach Revision hip replacement as well, pioneering new techniques and furthering education in this area.

He travels monthly across the United States to lecture and teach the procedure to other orthopaedic surgeons. He travels internationally as well to lecture and demonstrate the procedure for surgeons interested in the technique. Surgeons seeking training in the procedure travel to Louisville to watch him operate and learn the technique first hand. He hosts domestic and international surgeons weekly at Norton Brownsboro Hospital. He is also part of the training program at the University of Louisville and has been training residents and fellows since 2007.
Introduction

Hana® Table

**Allow Precise Control of Patient Position, Manipulation and Traction**

Proven performance for Anterior Approach to total hip procedures.\(^1\)
Allows bilateral hip replacement for qualified patients.

**Extensive Imaging Capability**

Un-restricted C-Arm access.
Radiolucent 35 inch (89 cm) cantelevered top section.
Radiolucent leg spars for uninterrupted imaging.

The Hana® table allows the surgeon to perform Total Hip Arthroplasty through a single Anterior Approach incision, without detachment of muscle from the pelvis, or femur. The table allows hyperextension, abduction, adduction and external rotation of the hip for femoral component placements. Minimizing the disturbance to the lateral and posterior soft tissues may help provide immediate stability of the hip after surgery.
OR Team Engineered
Facilitates OR Team performance.
Proprietary features make pre-operative and intra-operative protocol easier than a standard OR table

Suited to the Newest Technologies
Supports tissue-sparing techniques for MIS procedures.
Provides considerable level of surgical assistance for surgeon and OR team.
Before transferring the patient to the Hana® table, it is recommended that the patient’s feet be secured into the boots. Apply web roll around the foot, then self-adherent wrap (Coban™) around the upper ankle. With the boot liner out of the shell, position the foot inside the liner. Secure the tongue and the Velcro® strap then place the foot into the boot. Ensure that the heel drops down into the shell. Affix the buckle straps and securely tighten the foot. Test the stability of the boot on the foot by holding the ankle while pulling on the boot handle.

Position the patient on the Hana® table in preparation for surgery. Typically, the patient’s arms are placed roughly perpendicular outward and not over the chest. Arms placed on the chest can interfere with femoral preparation later in the procedure.

1. Use a clear U drape (non sterile) around operative area and towards the foot (Figure 1). A towel wrapped over each boot reduces the chance of perforation through the curtain.

2. Place two extra large drapes over the lower extremities starting distal to operative area. Place two large drapes across the top of the patient (Figure 2).

3. Staple three towels around operative area, one on each side of the incision area and one medial to the incision area (Figure 3).

4. Based on the type of revision surgery being performed, draping exposure may need to span from the knee up to the iliac crest (Figure 3).
5. Apply an impervious U drape with adhesive around the operative area and extending over the legs. Apply another in the opposite direction over the head.

6. Place a split drape with adhesive proximal and distal to the operative area.

7. Cover exposed skin with iodine incise drape (Figure 4).

8. Cut a small hole in the drape for the femoral hook lift, place the hook bracket on the lift and seal with iodine incise drape (Figure 5).

Room Set-up

The OR is set up such that the instruments are on the operative side of the patient. Generally, the use of 2 back tables (A), 1 Mayo stand (B) and 1 basin stand (C) is sufficient, creating an L-shaped area.

The C-Arm (D) is positioned on the non-operative side, perpendicular to the patient. A typical OR team will consist of the surgeon, physician’s assistant, anesthesiologist, scrub nurse, circulating nurse/table operator and X-ray technician (Figure 6).
Acetabular Revision

Introduction

Acetabular revision is where most surgeons start their revision experience through the Anterior Approach. It offers very direct exposure of the acetabulum and easy visualization for implant removal and placement. It should be noted that the posterior column and retroacetabular surface are not easily exposed and defects of the posterior acetabulum that require augmentation should be treated through a posterior approach. The anterior column and superior acetabulum however, are easily accessible for grafting or augmentation if necessary. Standard instrumentation for implant removal and implantation are easily used. The following will describe the technique for acetabular revision through the Anterior Approach.

Applications

Almost all acetabular component revisions can be performed through the Anterior Approach as it provides excellent exposure of the acetabulum. Head and liner exchanges can be performed easily with the advantage of decreased posterior releases and therefore potentially decreasing instability, which can be a frequent complication.

A unique feature of this approach is access to the anterior column of the acetabulum for augmentation of difficult defects that are not accessible from other approaches to the hip. Acetabular revisions not requiring additional augmentation are straightforward.

Considerations

The patient is placed supine on the orthopaedic table with arms out to the sides. The hip is prepped and draped in the same fashion as with primary THA.

The tensor fascia lata (TFL) anterior superior iliac spine (ASIS) can often be an impediment to proximal exposure. Patient size as well as pelvic and femoral anatomy can add additional complexity. Simple steps can be performed to allow adequate proximal exposure.

Proximal exposure can often be required for anterior wall defects as well. Regardless of the femoral or acetabular need, the proximal incision is similar.
Incision/Superficial Dissection

Mark the locations of the greater trochanter and the anterior superior iliac spine (ASIS). Start the incision approximately 2cm lateral and 2cm distal to the ASIS, and continue in a posterior and distal direction toward the anterior border of the femur. The incision will be 8–9cm and parallels the fibers of the TFL muscle.

Curve the incision posteriorly to center the distal aspect of the incision with the midline of the thigh.

The incision starts lateral and distal to the ASIS in the same alignment as a primary Anterior Approach (Figure 7).

It is ultimately important to stay lateral to the ASIS to avoid dissection directly into the Smith-Peterson interval. The goal is to come down onto the muscle belly of the TFL, which can help avoid injury to the lateral femoral cutaneous nerve.

The fascia is opened by blunt finger dissection between the TFL and Rectus Femoris. If this is a revision of a prior Anterior Approach, then the bovie will be needed to both open the fascia and dissect into the interval. It will be important to always stay in the scar plane, following the interval down to the anterior hip capsule, or pseudocapsule (Figure 8).

In a virgin dissection, the lateral femoral circumflex vessels will have to be identified and ligated or cauterized. A Gelpi retractor is placed in the interval between the TFL and rectus femoris to expose the anterior hip capsule or scar pseudocapsule (Figure 9).
Deep Dissection

During deep dissection, it is important to try to stay distal to the reflected head of the rectus femoris muscle to avoid incising it. Placement of a cobra retractor laterally and an army navy retractor medially can help with exposure of the reflected head of the rectus femoris muscle during this step (Figure 10).

Next, mark the location of the anterior and lateral capsular incisions in line with the neck of the femoral implant (Figure 11). Once the capsule is incised, tag sutures can be placed in the anterior and lateral capsule flaps as may be done in a primary procedure. The inner half of the capsule will need to be excised to facilitate further exposure (Figure 12).

Although the anterior capsule needs to be extensively thinned and released, try not to release the capsule from the saddle of the femur. The femur does not need to be released for simple acetabular revision and extensive femur releases can lead to instability.
Retractors are placed anterior and posterior to the acetabulum. The placement of the anterior retractor is the most difficult and the key retractor for excellent exposure. It is key to excise the inner half of the anterior capsule to the anterior acetabulum to allow placement of this retractor. External rotation of the leg will help with placement of this retractor. Once the anterior retractor is placed, the anterior and medial capsule can be released from the medial neck of the femur, which allows the surgical exposure to expand dramatically (Figure 13).

**Note:** Be cautious not to excise the psoas tendon when excising excess anterior hip capsule. If the femur is not to be revised, avoid release of capsule inside the saddle of the femur. Preservation of the saddle and posterior scar tissue provide stability and do not need to be released for acetabular revision alone.
Femoral Head Removal

With retractors anterior and posterior to the acetabulum, traction is placed through the orthopaedic table with the leg in slight internal rotation (Figure 14). The leg is internally rotated to allow the femoral head to be disimpacted with a bone tamp into the acetabulum. If the leg is in neutral or external rotation, the head will hit the anterior edge of the polyethylene and be difficult to remove.

Once the head is disengaged into the acetabulum, more traction is applied and a bone hook can be used on the anterior edge of the neck of the stem as the leg is externally rotated (Figure 15). This helps facilitate the head to roll off the trunnion as the leg is fully externally rotated to 90 degrees. Traction is released and the trunnion is placed postero-lateral to the acetabulum (Figure 16). The trunnion will not sit completely behind the acetabulum unless the lateral femoral capsule has been released, a step that can be added if the exposure is not adequate at this point. The head is removed anterior to the neck of the implant and access to the acetabulum is obtained anterior to the femoral neck.
Acetabular Cup Extraction

The polyethylene may need to be removed if a screw is present in the cup. A 3.2mm drill and a 6.5mm x 35mm screw can be used to remove the liner. Drill into the edge of the liner to create maximum screw threads into the liner before the tip hits metal. This will assure the screw doesn’t strip out of the polyethylene before the liner disengages (Figure 17). After backing the drill out, insert the 6.5mm x 35mm screw into the drill hole and advance it until the liner disengages from the cup. Finally, the liner can be removed with a kocher (Figure 18).

If no screws are present, the explant tool is now used to remove the cup. The standard straight handle for the explant tool works well. The technique is no different from other approaches to the hip. The small blade is inserted superior, anterior and posterior followed by the longer blade. The inferior portion of the cup can difficult to access via the Anterior Approach, but when the tool is rotated and the long blade is used, a 270 degree arch of motion is usually more than enough to remove even a well fixed acetabular cup (Figure 19).
Acetabular Cup Reaming

Reaming is performed in the standard fashion with re retractors in place to visualize the acetabulum if large defects are present (Figure 20). In the acetabulum with minimal defects, reaming can then be performed with fluoroscopic assistance as needed. This is an accurate way to control depth of reaming and positioning of the cup, and can greatly assist the novice Anterior Approach revision surgeon (Figure 21).

It is absolutely critical that the pelvis is level before the onset of reaming. The image intensifier is brought over the midline of the pelvis to visualize the pubic symphysis and both hip joints. The symphysis must be in midline with the sacrum and the relationship of the ilioischial line to teardrop must be symmetric. The appearance of the obturator foramen is a secondary check as it is common to have asymmetry with this anatomy. In between reamers, check the acetabular rim by feel with a finger.

Once the proper depth has been obtained and reaming has been performed out to the acetabular rim, any cavitary defects can be packed with bone graft, using the reamer on reverse to pack the graft.
Acetabular Cup Implantation

Finally, the cup is inserted under guidance of fluoroscopy in same fashion as a primary THA (Figures 22, 23, & 24). Screws are placed in the cup if necessary with fluoroscopy available to check screw position on oblique views if desired. If using the PINNACLE® Acetabular Cup System, please reference the PINNACLE Hip Solutions Surgical Technique.

Figure 22

Figure 23

Figure 24
Acetabular Defects and Augmentation

Most acetabular defects encountered in revision surgery are either cavitary or small segmental defects. Metal augments can be used when the large bone deficiency exists and additional support is needed on the superior side of the acetabular cup.

Through the Anterior Approach, access is easily obtained to the anterior wall, anterior column, superior acetabular dome and posterior superior wall. Access to the posterior column or large defects of the posterior wall are not easily accessible through this approach.

GRIPTION® TF Acetabular Augments

If acetabular augmentation is required, access to the superior lateral acetabulum is easily obtained by extending the standard incision proximally to the ASIS, then curving it lateral to follow the iliac crest. The dissection is carried through the interval between TFL and rectus femoris and extended proximally to the ASIS staying in this interval. The TFL can be released off the iliac crest over a 1 cm 2 cm area to allow the muscle to be retracted laterally (Figure 25). It is important not to take the release too far lateral across the origin of the iliobibial band (IT Band). The TFL origin can be easily repaired to the iliac crest with interrupted absorbable suture. The gluteus minimus and medius can be reflected off the ilium using a Cobb elevator and hip capsule opened, allowing full access to the superior and lateral acetabulum. The muscles are not completely released over their entire origin so no formal repair is required. This allows access for smaller structural grafts like those needed in developmental hip dysplasia or larger defects in revision surgery.

The GRIPTION® TF Acetabular Revision System is an innovative technology for addressing bone defects in complex acetabular revision surgery. The GRIPTION TF Augments are designed to act as a defect filling implant in the case of severe bone loss in the acetabulum (Figure 26). For additional information, reference the GRIPTION TF Design Rationale/Surgical Technique.
GRIPTION TF Acetabular Buttresses and Shims

Direct access of the anterior column is possible for cup removal and reconstruction through the Anterior Approach. The incision is extended proximally to the ASIS, then curved lateral to follow the iliac crest. The dissection is carried through the interval between TFL and rectus femoris and extended proximally to the iliac crest releasing the abdominals from the iliac crest. The sartorius and inguinal ligament are released from the ASIS and the anterior border of the pelvis is cleared past the anterior inferior iliac spine.

Next, the entire inner table of the pelvis is exposed along with the entire proximal femur. This allows the intrapelvic cup to be removed by direct access. With the protrusio defect, it is much easier to remove the cup with the femoral component removed. The trunnion interferes with access and removal of the femoral component allows more room for both acetabular cup removal and reconstruction.

With all implants removed, the remaining bone stock is assessed with a sharp Hohmann retractor placed into the superior pubic ramus medially and a blunt Cobra placed around the posterior wall. Reaming is performed under direct visualization until 2-point fixation is obtained between the ischium and the superior lateral acetabulum. The cup is impacted and screws are placed into the posterior wall and column. Inferior screws into the ischium are ideal if obtainable. The anterior half of the cup is exposed without support and an anterior column augment is placed on the inner table of the pelvis. The augment is fixed to the inner table of the pelvis with screws and bone cement is placed between the augment and cup to provide immediate stability to the construct.

The GRIPTION TF Buttress is designed to support the shell in a similar manner as the Augments. It is important to note the Buttress implant spans the defect in the acetabulum and must be cemented to the shell (Figure 27).

Note: Figure 27 shows a GRIPTION TF Buttress in place for a posterior column defect, which may be difficult to achieve through the Anterior Approach. Anterior column defects are more easily managed through the Anterior Approach.

The GRIPTION TF Shim Implants are designed to mate with the Buttress via cement to raise the end of the Buttress when pelvic geometries require support (Figure 28). For additional information, reference the GRIPTION TF Design Rationale/Surgical Technique.
Protrusio Cage

The Protrusio Cage (Figures 29 & 30) offers an option for the revision acetabulum. The Protrusio Cage may be considered as a method of cemented acetabular reconstruction when traditional biologic fixation with a hemispherical porous-coated acetabular component is not possible. It is important to note that the Protrusio Cage is only compatible with ENDURANCE® All-Polyethylene Cemented Cups (Figure 31).

The reinforcement provided by a Protrusio Cage allows fixation of an acetabular cup prosthesis, which can be fixed inside the Protrusio Cage using bone cement.

For more information, reference the Protrusio Cage Surgical Technique.
Iliac Wing Osteotomy

In most cases, revision of the acetabular cup via the Anterior Approach is not as challenging. Femoral exposure, however, can be challenging due to either broach obstruction by the anterior superior iliac spine (ASIS)/ilium, large musculature, and/or a poor trajectory down the axis of the femur. For cases in which an Anterior Approach primary hip arthroplasty was performed and the femoral component fails, an iliac wing osteotomy can be considered to facilitate femoral exposure if the surgeon desires to revise the femoral component via the Anterior Approach. The purpose of the iliac osteotomy is to improve exposure of the proximal femur via the Anterior Approach with minimal soft-tissue morbidity. The following technique provides general guidelines for an iliac wing osteotomy.

Once standard exposure has been achieved for femoral revision, access down the axis of the femur for stem removal can be challenging. To facilitate exposure for an iliac wing osteotomy, the incision is extended proximally straight over the iliac crest, slightly lateral to the ASIS (Figure 32).

Sharp dissection is carried down to the iliac crest. The insertion of the abdominal external oblique aponeurosis is incised off the outer crest. Care should be taken to remove the aponeurosis as it inserts around the lateral aspect of the iliac crest; the surgeon should also avoid injury to the origin of the tensor or the iliotibial band. The iliacus muscle is then bluntly dissected off the internal iliac fossa. The sartorius muscle and inguinal ligament are detached from the ASIS and blunt dissection is continued down into the interspinous notch to the anterior inferior iliac spine (AIIS) (Figure 33).

The lateral femoral cutaneous nerve is not exposed during the dissection. The surgeon should avoid detachment of the direct head of the rectus femoris from the AIIS. Once the iliac fossa is exposed, the osteotomy is made. An oscillating saw is used to cut the iliac crest “inside-out” (Figure 34).
An osteotome is used to complete the osteotomy of the outer cortex of the ilium. The iliac fragment should be approximately 70 mm long and 25 mm from the crest. The osteotomy should extend from the lateral ridge of the iliac crest (approximately 5–6 cm proximal to the ASIS) to the anterior border of the AIIS. The AIIS should not be included in the osteotomy, and the direct head of the rectus femoris should be protected. The osteotomized ilium with the attached tensor muscle is then gently retracted posteriorly. This exposure allows for adequate access to the proximal femur as well as a facile trajectory down the femoral canal (Figure 35).

Once the revision of the femoral component is completed, the osteotomy is repaired using two 3.5 mm cortical screws. It is advised to review placement of the screws on intraoperative

Once the osteotomy is fixated, the sartorius and inguinal ligament attachments is repaired to the ASIS using a drill hole and a #1 Coated VICRYL® (polyglactin 910) Suture. The external abdominal oblique aponeurosis is repaired to the fascia lata using a #1 VICRYL Suture. The fascia over the tensor is repaired using a #1 VICRYL Suture. The skin is closed with 2–0 VICRYL Suture, 3–0 MONOCRYL® (poliglecaprone 25) Suture, and DERMABOND® PRINEO® Skin Closure System.

Conclusion

In summary, this describes a technique which may aid in performing revision of the femoral component through the Anterior Approach. The authors recognize that femoral component revision surgeries are not always best performed via the Anterior Approach and this technique describes a potentially helpful technique to facilitate femoral exposure and minimize soft-tissue compromise. Hip capsule release, muscle relaxation, and understanding of pelvic anatomy are key aspects of this procedure. Further prospective studies on this technique should be performed to determine its morbidity and efficacy compared to other revision techniques.
Femoral Revision Surgical Tips

Introduction

Femoral revisions can be challenging regardless of approach. While the Anterior Approach does not offer the same exposure to the femur as other approaches, it does offer advantages that make femoral revisions through the Anterior Approach a reasonable, and in some cases, the preferred option.

Femoral revision via extended trochanteric osteotomies as well as modified anterior ostoeomies can afford excellent femoral exposure that can be performed through the Anterior Approach. Potential advantages of this approach include the use of fluoroscopy to assist with osteotomy levels, removal of cement, confirmation of stem placement, as well as leg length and offset checks familiar to most primary anterior surgeons. It should be noted that the exposure of the trochanter is limited by this approach.

Applications

Periprosthetic fractures, femoral osteotomies, cortical windows, insertion of modular long stemmed prosthesis, limb preservation implants, and total femoral replacements require distal femoral exposure. The Anterior Approach revision incision is an extensile incision that can be extended distally to the knee as needed for femoral revision.

Indications for femoral revision via the Anterior Approach include:

- Loose femoral implants
- Well fixed implants
  - Complete access from above
  - Distal cortical window
  - Femoral Episiotomy
  - Modified Anterior Osteotomy
  - Extended Trochanteric Ostoeomy
- Peri-prosthetic fractures
  - Loose
  - Well fixed
Incision/Superficial Dissection

Mark the locations of the greater trochanter and the anterior superior iliac spine (ASIS). Start the incision approximately 2cm lateral and 2cm distal to the ASIS, and continue in a posterior and distal direction toward the anterior border of the femur. The incision will be 8–9cm and parallels the fibers of the TFL muscle.

Curve the incision posteriorly to center the distal aspect of the incision with the midline of the thigh.

The incision starts lateral and distal to the ASIS in the same alignment as a primary Anterior Approach (Figure 37).

It is ultimately important to stay lateral to the ASIS to avoid dissection directly into the Smith-Peterson interval. The goal is to come down onto the muscle belly of the TFL, which can help avoid injury to the lateral femoral cutaneous nerve.

The fascia is opened by blunt finger dissection between the TFL and Rectus Femoris. If this is a revision of a prior Anterior Approach, then the bovie will be needed to both open the fascia and dissect into the interval. It will be important to always stay in the scar plane, following the interval down to the anterior hip capsule, or pseudocapsule (Figure 38).

In a virgin dissection, the lateral femoral circumflex vessels will have to be identified and ligated or cauterized. A Gelpi retractor is placed in the interval between the TFL and rectus femoris to expose the anterior hip capsule or scar pseudocapsule (Figure 39).
General Strategies for Femoral Revision

Removal of the femoral stem should be done with as little damage to the femoral bone as possible and exposure is key. Initial steps should be to work proximally along the bone-stem interface to loosen and/or remove the femoral stem if possible to avoid osteotomies of the femur.

After exposure of the hip the femoral head is removed from the trunnion as described in the acetabular revision section. The femur is externally rotated and mobilized, detaching capsular attachments from the intertrochanteric line and the calcar area exposing the upper greater trochanter (Figure 40).

The Hana® table femoral hook is placed around the proximal femur and the leg is maximally externally rotated, extended and adducted with the leg spar resting on the floor. The capsule and scar attached to the medial greater trochanter should be detached and a circumferential view of the proximal femoral stem obtained (Figures 41 & 42).

Expose the entire lateral portion of the proximal stem, often by passing an osteotome along the proximal lateral surface of the implant. If the stem is loose, removal will not be difficult once adequate exposure is achieved.
Removal of Partially or Fully-Fixed Uncemented Stems

A partially fixed stem may show apparent movement between the stem and the proximal bone, and in some cases, such a stem may be removed by applying forces to separate the bone-stem interface.

One technique option is to drill a shallow 4mm diameter hole into the inferior neck of the femoral stem, adjacent to the trunnion with a carbide drill bit. Then, place the tip of a bullet-tip stem impactor into the 4mm hole and apply force in a proximal direction. You may also use this technique to apply force distally, alternating distal and proximal forces to loosen the bone-stem interface. Another option is to use a slaphammer attached to the proximal end of the stem in similar fashion to apply proximal and distal forces to loosen the stem (Figures 43 & 44).

If the stem cannot be extracted with standard extraction equipment at this time, work around the proximal stem with thin osteotomes, smooth K-wires on a drill, and/or a pencil-tip burr to further free the bone-stem interface. Attempt removal again with additional proximal and distal forces to break the stem free from the bone.

If initial exposure precludes directing osteotomes in an effective direction, parallel to the stem, and iliac wing osteotomy may be considered. Following an iliac wing osteotomy, straight instruments can be easily directed along the axis of the stem and femur. Consider that the iliac wing osteotomy is a step that may have less potential for problems than a femoral osteotomy and potentially a smaller effect on the post-op course of care.¹
If the stem cannot be removed after working from proximal and freeing at least the proximal 3 to 5 centimeters of the stem, a femoral osteotomy will be likely, with options discussed in the next section of this document. Once the proximal portion of the stem is free, a postero-lateral cortical window is often sufficient for stem removal. Limiting the osteotomy to this window preserves the proximal cylinder of the femur that includes the greater and lesser trochanters.

The proximal extent is at or slightly distal to the level that the stem was freed from the bone proximally. The distal extent is usually slightly proximal to the tip of the femoral stem. The posterior border is just anterior to and parallel to the linea aspera. These first 3 cuts may be made with a thin (0.6mm) oscillating saw blade. If possible, preserve muscle attachment to the cortical window and complete the antero-lateral osteotomy with drill holes through the vastus muscle or by directing a drill or saw from the posterior cut, anteriorly and lateral to the stem. Hinge the window anteriorly along its anterior border and retract it, along with the vastus muscle, with a Hohmann retractor. Working anterior and posterior to the stem through the window will provide adequate mobility of the stem to allow removal with a mallet and impactor inserted in the 4mm hole that was drilled in the trunnion of the stem.

Once the femoral stem has been removed, a new and longer revision femoral stem can be prepared for and implanted, or the femoral bone may be fixed back together first, usually with cerclage cables or wires. Another option for fixing the bone back together is a 3.5 mm lag screw placed from lateral to medial near the linea aspera. This screw should be positioned posterior to the new femoral stem. Depending on the situation, the new stem may be a longer primary-type stem. It is suggested to avoid extra-long revision stems if they are not clearly necessary.

**Removal of Cemented Stems**

Expose the proximal femur and utilize an iliac wing osteotomy if necessary for exposure. Remove the bone cement around the proximal portion of the femoral stem. If necessary, use a drill hole adjacent to the trunnion of the stems as explained previously to removal the femoral stem with proximal blows. Complete proximal cement removal once the primary stem is removed. Use a distal cortical window as described above when distal cement removal becomes difficult or there is significant danger of perforating or fracturing the femur during cement removal. Use the image intensifier to confirm instrument position in the femoral canal as well as complete cement removal.

In the following section, the Modified Anterior Osteotomy (MAO) and Extended Trochanteric Osteotomy (ETO) are explained in detail and can be utilized when maximum intramedullary exposure is necessary.
Extended Distal Femoral Exposure

To expose the femur distally in revisions that may require a femoral osteotomy, dissection along the entire length of the TFL is possible (Figure 45).

Carry the incision posteriorly to place the incision just anterior to the femur. Dissection occurs at the interval between the TFL and vastus lateralis (Figure 46). Reflection of the vastus lateralis anteriorly via a subperiosteal approach will allow for direct femoral visualization.

Figure 45

Figure 46
The dissection is carried down as the TFL distally attaches to the IT Band (Figure 47). The dissection then occurs at the anterior border to separate between the TFL and Vastus Lateralis.

The interval between the TFL and vastus lateralis should be followed to remain within the inter nervous plane (Figure 48). The illiotibial band is then divided longitudinally down the leg, providing access for a subvastus approach to the femur.

To expose the posterior border of the vastus lateralis, the Hana® table is internally rotated, often times 90 degrees, to help facilitate exposure. The exposure also allows a vastus splitting approach if a modified anterior osteotomy is required (Figure 49 & Figure 50).
Femoral Osteotomy options

If removal of the primary femoral stem requires an osteotomy, there are multiple options available to achieve this through the Anterior Approach revision exposure.

1. Modified Anterior Osteotomy
2. Extended Trochanteric Osteotomy
3. Distal Cortical Windows
4. Chevron Trochanteric Osteotomy
   (not included in this guide)

The Hana® table is used to assist with internal or external rotation as needed for femoral exposure throughout the preparation of the osteotomy.

Modified Anterior Osteotomy

This osteotomy allows extensile exposure of the proximal femur to facilitate exposure of the bone/implant surface and or exposure of cement. This osteotomy can be of varied lengths depending on necessity.

Exposure for the anterior osteotomy utilizes the typical extensile Anterior Approach. Dissection is carried out between the interval of TFL/IT Band and Vastus Lateralis. The leg is kept in a neutral position on the Hana® table and the vastus lateralis is exposed from proximal to as far distal as required.

Generally, the lateralis muscle is reflected anteriorly to expose the proximal femur, maintaining attachment proximally (Figure 51). This type of osteotomy allows access to both the calcar region as well as the posterior trochanter. Access to the posterior femur is not permitted via this osteotomy.

The posterior limb of the osteotomy is generally centered laterally and is best performed through the mid substance of the lateralis. However, splitting of the lateralis muscle may cause denervation of the muscle fibers posterior to the split.
**Posterior Osteotomy Limb:**
This generally occurs at the same location the vastus lateralis is split. A thin oscillating saw may be used. The proximal portion of the posterior cut reaches to the greater trochanter. The distal extension occurs as far distally as required (Figure 52).

**Distal Osteotomy Limb:**
The goal is to include between 1/3 and ½ of the anterior femur. Generally this equates to 10 to 15mm of length. This is often best accomplished using a pencil-tip burr to make a beveled and curved cut.

**Anterior Osteotomy Limb:**
Proximally the limb can be initiated with a thin sagittal saw. Care is made to avoid being too medial to avoid the calcar. This can generally be extended 1 to 2 cm before encountering the vastus intermedius. The distal limb can also be initiated from the distal curved osteotomy with a thin sagittal saw. Connection of the two limbs is best performed via drill holes through the vastus intermedius to preserve the blood supply to the bone pedicle.

**Completion of Osteotomy:**
Finally, the bony flap is reflected anteriorly with the use of multiple osteotomes. This technique provides maintenance of blood supply via the vastus intermedius. (Figure 53).
Extended Trochanteric Osteotomy

Exposure:
Exposure for an extended trochanteric osteotomy utilizes the typical extensile Anterior Approach. Dissection is carried out between the interval of TFL/IT Band and Vastus Lateralis. The leg is internally rotated on the Hana® table to provide a subvastus approach to the femur distally. Exposure for the anterior limb of the osteotomy is generally with the leg neutral or slightly externally rotated (Figures 54, 55, & 56).

Figure 54

Figure 55

Figure 56
Expose the distal vastus lateralis by internally rotating the femur. Release and reflect the lateralis anteriorly from a subperiosteal approach (Figure 57).

A Cobb Elevator can be used to release tissue as needed for further access to the femur (Figure 58).
Mark the distal extent of the osteotomy based on pre-operative plan and/or confirm with fluoroscopy (Figures 59 & 60).
**Posterior Osteotomy Limb:**

Mark the path of the osteotomy with a marking pen (Figure 61).

Complete the posterior portion of the osteotomy first. This is facilitated by maximum internal rotation of the femur, often to 90 degrees on the Hana® table.

Exposure occurs in a subvastus technique. Once the distal aspect of the osteotomy is confirmed via fluoroscopy, the distal cut can be made with a thin oscillating saw (Figure 62).
The osteotomy starts distally and is carried proximal to the lateralis ridge. The final proximal portion of the osteotomy is carried posterior to the trochanter with an osteotome in order to avoid damaging abductor muscles. (Figure 63).

Figure 63
**Distal Osteotomy Limb:**

Extending the distal osteotomy anteriorly requires attention to detail as this can be the site of distal fractures and unwanted extension. Making a slightly beveled, curved vertical osteotomy helps to avoid these mistakes. The goal is to include between 1/3 and 1/2 of the anterior femur. Generally, this equates to about 10-15mm of length. This is often best accomplished with a beveled and curved cut utilizing a pencil tip burr (Figures 64, 65, & 66).

The femur remains internally rotated at 90 degrees for this step of the osteotomy.
**Anterior Osteotomy Limb:**

Proximally the limb can be initiated with a thin sagittal saw. This can generally be extended 1 to 2 cm before encountering the vastus lateralis.

The Distal limb can also be initiated from the distal curved osteotomy with a thin sagittal saw (Figure 67). Connection of the two limbs is best performed via drill holes through vastus lateralis to preserve the blood supply to the bone pedicle.

**Completion of Osteotomy:**

Finally, the bony flap is reflected anteriorly with the use of multiple osteotomes to expose the femoral stem. This technique preserves the muscular attachments of the abductor muscles and vastus lateralis muscle (Figures 68 & 69).
Femoral Stem Removal

To remove the femoral stem, a high speed burr can be used to free the interface around each side of the stem (Figure 70).

Once sufficient burring is complete, the femur can be rotated slightly internal with the osteotomy closed over the femoral stem to expose the neck (Figure 71).
A slaphammer can then be attached to the neck of the femoral stem, allowing full removal of the stem from the bone (Figures 72, 73, and 74).
Repairing the ETO

The osteotomy can then be closed and secured with 1.7 mm cables (Figures 75, 76, 77, and 78). If using the DePuy Synthes Orthopaedic Cable System, please reference the Orthopaedic Cable System Surgical Technique.

Generally, three to four cables are required to close and repair the osteotomy. The cables are passed under vastus lateralis and then around the femur. Care must be taken for good opposition and adequate symmetric tightening of the cables.
Revision Stem Femoral Preparation

Once the ETO is closed and secured, preparation for a distal fixation revision stem can begin (Figure 79).

Radiographic images can be taken during preparation to confirm appropriate depth for the revision stem as well as accurate closure of the ETO (Figure 80).
Reaming of the distal femoral canal in preparation for a modular revision stem, such as RECLAIM® Modular Hip Revision System can occur at this time. Once the femoral canal is prepared appropriately, the distal stem implant can be inserted (Figure 81). If using the RECLAIM Modular Hip Revision System, please reference the RECLAIM Modular Hip Revision System Surgical Technique.

Reaming of the proximal femur in preparation for the proximal body implant occurs next. Once the proximal bone is fully prepared, the proximal body trial can be inserted for testing initial trial range of motion if desired. Next, the final proximal body implant can be inserted and assembled to the distal stem (Figure 82).

Once all final implants are inserted, closing of the fascia, subcutaneous tissue, and skin can be carried out in standard fashion and per surgeon preference. A final X-ray can be taken to ensure proper implantation of components and post-operative discussion with the patient.
References:

Please note: Anterior Approach is not approved for use with the CERAMAX® Ceramic Total Hip System.

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