Direct Anterior
Direct Anterior Instrumentation

Surgical Technique
The decision to perform a Direct Anterior procedure is ultimately left to the surgeon’s professional medical and clinical judgment. It is the surgeon who must carefully evaluate each patient to determine if Direct Anterior surgery is indeed appropriate. In some cases, performing an unfamiliar surgical technique may be associated with clinical risks. Stryker strongly recommends that surgeons complete a formalized training program before attempting these operative techniques on their own.
### Retractor Tray

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### Acetabular Tray

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Observe that components are not visibly damaged prior to use. Examine instrumentation against the tray layout to ensure all parts are accounted for (prior to and following surgery) and available for use.

*Not for use with the Direct Anterior approach.
Retractors

- A variety of retractors including Hohmann, Mueller and Cobra style retractors are supplied in the set.
- These include retractors of different widths and profiles to accommodate various exposure objectives and should be used at the discretion of the operating surgeon.
For Acetabular Preparation

- The Cup Impactor interfaces with Stryker Trident and Tritanium cups via a modular bolt. The bolt provides a method for repeated attachment and detachment of the cup impactor.

- The Supine Alignment guide offers a visual reference to estimate cup inclination and anteversion during impaction and is designed to aid the surgeon in placing the acetabular shell in approximately 45° of inclination and 20° of anteversion. (Proper positioning of the shell should be at the discretion of the operating surgeon).
For Femoral Preparation
• The Femoral Head Extractor and T-handle are designed for removal of the femoral head.
• The Bone hook aids in elevation of the femur during femoral preparation.
• The Angled Curette aids in sounding of the femoral canal prior to broaching and removal of lateral bone.
• The Modular Box Osteotome attaches to the Dual-Offset Handle and helps prepare the superolateral femoral neck.
• The Reverse-Cutting Rasp attaches to the Dual-Offset Handle and aids in lateralization and improving access to the femoral canal.

Dual-Offset Handles
• The Right and Left Dual-Offset Handles provide soft tissue clearance during preparation of the femoral canal.
• The Quick-Connect Handle may be attached to the Dual-offset handle to provide version control of the broaches.
Preoperative planning aids in the selection of the appropriate implant style and size for the patient’s hip pathology. Preoperative X-ray analysis can be used to evaluate:

- Optimal femoral stem fit
- Prosthetic neck length
- Neck offset
- Acetabular component sizing
- Correct location of the osteotomy

Place the patient in a supine position on the operating table to create a predictable and stable pelvis position. One option is to place a hip bump under the pelvis as part of patient positioning to elevate the pelvis. This can facilitate femoral exposure if a special table is not used.
**Figure 1** When preparing the femoral canal, the patient’s leg will need to be repositioned with the operative leg placed in external rotation, adduction, and extension. Place the patient in the supine position. During femoral preparation, adduction of the operative leg will aid in access to the femoral canal. For this reason, a table attachment (such as an armboard) on the non-operative side may accommodate abduction of the non-operative leg.

Draping both legs is not absolutely necessary (as noted in Figure 1). Special fracture tables may also be used for leg manipulation, but are not presented within this technique.

**Figures 2-3** Palpate the anterior superior iliac spine (ASIS) and the greater trochanter. Begin an incision two finger breadths lateral (~ 3 cm) and one to two finger breadths distal to the ASIS and extend it distally.

Keep the initial incision small (8-10 cm) and extend as needed.

NOTE

The location of the incision is significantly more lateral than the traditional Smith-Petersen interval. This is done to avoid the lateral femoral cutaneous nerve (LFCN) situated near the interval.
Figures 4-7 Once the skin is incised, confirm the location of the tensor fascia latae (TFL). Look for the white fascia of the gluteus medius and perforating vessels of the IT band at the lateral border of the tensor. The main branches of lateral femoral cutaneous nerve will be medial to the tensor.

Palpate the interval between the TFL and the sartorius muscle along its length. Access to this interval will be established strictly lateral under the fascia of the TFL to avoid damage to the LFCN.
**Figure 8** Incise the fascia of the TFL slightly medial to its midpoint and extend the incision in-line with the muscular fibers.

**Figure 9** Bluntly dissect the fascia from the tensor and perform the following steps strictly under the fascia. Gently pull the TFL muscle laterally to identify the Smith-Petersen interval. This interval is characterized by a fatty layer and the deep layer of the fascia latae that is covering it.

**Figures 10-11** Palpate the supero-lateral region of the femoral neck and place the first blunt retractor (1) in this location.

**Figure 12** Place a sharp retractor (2) infero-lateral to the greater trochanter. Use a rake or Hibbs retractor medially.

Excessive retraction force may result in bone, nerve or soft tissue damage. Proper retractor placement and adequate exposure are strongly recommended and described throughout the technique.

This technique describes the Hohmann retractors generally as “sharp” retractors and the Cobra retractors as “blunt” retractors.

**NOTE**
Retractor selection may be interchangeable at the discretion of the surgeon.

**Instruments**

- **Hohmann retractors**: 1440-2031, 1440-2032, 1440-2033
- **Cobra retractors**: 1440-2040, 1440-2041
**Figures 13-14** Identify the ascending branches of the lateral circumflex vessels and cauterize or suture as necessary. The branches are variable in number and size and can be a source of significant bleeding.

**Figure 15** The anatomic dissection shows the proximity of vascular structures and the ascending branches of the lateral circumflex vessels.
Once the vessels are controlled, incise the fascia (i.e.; the deep layer of the iliotibial band) between the rectus femoris and the TFL, revealing the vastus lateralis. Cut this strong fascia between the rectus femoris and the capsule with an electrocautery device until the precapsular fat pad is visible.

**Figure 16** Palpate the soft spot inferomedial to the neck and proximal to the vastus lateralis muscle.

**Figures 17-18** Place a blunt retractor (3) in this location, retracting the rectus femoris and sartorius and more completely exposing the anterior capsule prior to performing the capsulotomy.
**Figure 19** After releasing the fascia under the rectus, flex the hip. For additional exposure use a Cobb elevator to prepare space for a fourth retractor at the anterior rim of the acetabulum.

Keep the Cobb elevator aligned perpendicular to the ilio-inguinal ligament (parallel to the femoral neck) and on bone to avoid injury to the femoral nerve or the vascular bundle.

**Figure 20** Exchange the Cobb elevator with a fourth sharp retractor (4) (Curved Hohmann recommended).

**Figures 21-22** Keep the retractor perpendicular to the ilioinguinal band and under the ilipsoas muscle to avoid any damage to the neurovascular bundle.

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**Instruments**

*Curved Hohmann retractor*

1440-2030
If necessary, incise the reflected head of the rectus femoris at its capsular origin.

Depending on stiffness of the capsule, a variety of capsulotomies or capsulectomies can be performed. However, each method involves careful detachment of the capsule from the femoral neck.

**Figures 23-24** Incise the capsule in line with the axis of the femoral neck, beginning near the acetabulum and extending to the intertrochanteric line. This incision may form the center of an H-shaped capsulotomy, with the sidelines of the H extending along the acetabular rim and the intertrochanteric line.

Alternatively, the anterior capsule may be removed. Create an incision parallel to the first, but further medial. Then detach the inferior portion of the capsule along the acetabulum and along the base of the intertrochanteric line. Incise the superior portion along the trochanteric line. Then cut along the acetabulum and extend distally.

**Figures 25-26** Reposition the supero-lateral (1) and infero-medial retractors (3) inside the capsule. The blunt retractors are designed to protect the tip of the greater trochanter during the femoral neck osteotomy.

Carefully clear the “saddle” region between greater trochanter and the neck as this serves as starting point for the neck osteotomy. When the capsule has been prepared for femoral neck osteotomy the surgeon should have a clear view of the superolateral acetabulum and the saddle, and should be able to freely palpate the lesser trochanter.
Figures 27-28 Create a double osteotomy of the neck so that a wedge of the neck may be removed prior to the femoral head. Use a narrow or restricted-motion saw to avoid damage to the greater trochanter and other surrounding structures.

Ensure that both cuts are parallel or create a wedge that is wider at the anterior for ease of removal. Start the proximal cut as close to the femoral head as possible.

Begin the second cut from the saddle region of the neck and extend it to approximately 1cm above the lesser trochanter at approximately a 45 degree angle or according to your preoperative templating.

Figure 29 Use a Cobb elevator or osteotome to mobilize the neck wedge.

Remove the neck wedge with a towel clamp or tenaculum. Gentle traction on the leg will aid removal of the wedge and the femoral head.

Figures 30-31 Drill the Femoral Head Extractor into the femoral head and slowly pull the head out using a T-Handle.

NOTE
Remove any osteophytes at the anterior rim of the acetabulum that may impede removal of the head.

Instruments

<table>
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<td>Femoral Head Extractor</td>
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**Figure 32** Maintain the retractor at the anterior rim of the acetabulum (1). Remove all other retractors. Place a second retractor (2) infero-medial around the transverse acetabular ligament (TAL).

Place a third retractor (3) postero-lateral to the acetabulum. A fourth retractor can also be used to enhance exposure. Occasionally it is necessary to make a small incision of the capsule to facilitate placement of the retractor.

Remove the remainder of the labrum.

**Figure 33** Incise the dorsal capsule (it usually forms a roll) in the region directly posterior to the acetabulum.

**Figures 34-35** Place a fourth, Mueller retractor (4) at the posterior rim of the acetabulum. This retractor can be held in place by the first assistant or using weights.

**Instruments**

- **Short Prong Mueller retractor**
  
  1440-2021
**Figure 36** Select the first reamer as described in the surgical protocol for the planned acetabular implant. Use care introducing and removing the reamer. Use an Offset Reamer Handle to avoid impingement with lateral tissue and excessive force against the anterior acetabular wall.

**Figure 37** As an alternative, introduce the reamer into the surgical site by hand and then attach the reamer handle. After reaming, use a clamp to retract the locking mechanism of the reamer handle and remove the reamer handle and reamer separately.
STEP 8
CUP INSERTION

Implant the cup using the Curved or Straight Cup Bolt Impactor with the Cup Impactor Bolt.

**Figure 38** Fully thread the bolt onto the cup. Insert the cup into the surgical site by hand.

**Figures 39-40** Alternatively, insert the cup using the impactor, positioning the cup on the impactor so that any screw holes are oriented as desired. Impact the cup in a manner consistent with its respective protocol. Avoid misdirected or excessive force.

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**NOTE**

The impactor may be detached from the bolt. By keeping the bolt attached to the cup, the cup may be assessed for orientation and quickly reattached to the impactor if needed.

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**Figures 41-42** To remove the bolt, partially loosen it by rotating the impactor counterclockwise. Remove by hand, with the Straight Cup Impactor or with the U-Joint Bolt Driver if access to the bolt is limited.

**Figure 43** If the cup needs to be repositioned after trial reduction, use the Straight Cup Impactor or the U-Joint Driver to re-insert the bolt. Screw forceps will help control the U-joint driver during reinsertion.

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**Instruments**

- Curved Cup Bolt Impactor: 1440-2010
- Straight Cup Bolt Impactor: 1440-2019
- U-Joint Bolt Driver: 1440-2017
- Cup Impactor Bolt: 1440-2011
Figures 44-45  Slide the Alignment Guide onto the Cup Impactor and rotate it around the spindle to the desired location. Align the plane of the two crossbars (line A) parallel to the frontal pelvic plane (line B). The frontal plane passes through the left and right ASIS and the pubic symphysis. This provides a visual approximation of 20° anteversion. Be sure to account for pelvic tilt when aligning crossbars to the floor or OR operating table.

Figure 46  Align the side-specific crossbar (line C) with the mid-sagittal plane of the pelvis (line D). The mid-sagittal plane can be approximated as the long-axis of the body. This alignment provides a visual approximation of 45° cup inclination.
**STEP 9**

**SCREW PLACEMENT (OPTIONAL)**

**Figures 47-48** If screw fixation is desired, use a flexible drill and drill guide.

**Figure 49** Use a u-joint screwdriver or flexible screwdriver to place the screws.

**STEP 10**

**LINER INSERTION**

**Figures 50-51** Insert the appropriate liner and seat it using a liner impacter. Figure 51 pictures the Insert Positioner/Impactor Handle (2111-0000B), however the surgeon should follow the recommended instrumentation in the surgical technique that matches the liner being implanted.
Figure 52 Remove the postero-lateral acetabular retractors. Position the leg in adduction and external rotation. Place a sharp retractor infero-lateral to the greater trochanter. Place a double-pronged retractor posterior to the greater trochanter, between the external rotators and the capsule.

Grasp the posterolateral capsular flap and use electrocautery to dissect the capsular and fatty tissue until the short external rotators are visible (e.g. piriformis, obturator, gemelli).
**STEP 12**

**FIGURE 4 POSITION TO MARK FEMORAL ORIENTATION**

*NOTE*
Optional for standard OR table users only.

**Figures 53-54** Remove all retractors. Externally rotate the leg and flex the knee into a “Figure 4” position. Place one Mueller retractor medial and one sharp retractor lateral to the femur, exposing the resected calcar region.

Remove any capsular tissue covering the calcar region.

**Figures 55-56** Mark the neutral rotation of the femur with electrocautery. Knee flexion is only used for calcar exposure and determination of the neck version.

**STEP 13**

**EXPOSURE OF THE FEMUR**

**Figures 57-58** For femoral exposure abduct the non-operative leg. After extending the leg 30°-40° with no knee flexion the foot is externally rotated and is adducted to expose the cut surface of the femoral neck.

*NOTE*
For standard OR table users leg extension is facilitated by breaking the midpoint of the OR table.

If both legs are draped, the operative leg can be crossed under the non-operative leg and an assistant’s hand in order to support external rotation. Keep the knee of the operative leg extended in order to reduce muscular force at the proximal femur and to increase exposure.
With the patient’s perineum positioned at the hinge of the bed, hip extension, rather than back extension, is achieved by lowering the foot of the bed. Putting the patient in Trendelenberg allows more hip extension without risking contaminating the foot of the bed. Prior to leveling the bed, it is important to first raise the foot of the bed to avoid contamination that may result from removing the Trendelenberg first. If a fracture table or leg holder device is used, follow the manufacturer’s instructions to achieve proper patient position.

**Figure 59-61** Place a Long-Prong Mueller retractor (1) behind the superior aspect of the greater trochanter, in front of the gluteus medius. Place the Bone Hook inside the calcar region of the resected neck and slowly elevate the femur anterolateral. Adjust the Long Prong Mueller as needed to maintain the femoral elevation. Always combine pulling of the bone hook and levering of the retractor to minimize forces to the greater trochanter. Releases of posterior structures may be required to achieve proper femoral exposure.

**NOTE**

For surgeons that use a special table, external rotation, extension and adduction is achieved through manipulation of the table attachment. Both techniques require this specific leg position to provide for a safe exposure of the proximal femur.

**NOTE**

In some cases, the tip of the greater trochanter is behind the acetabulum. Pull the Bone Hook first laterally in order to free the greater trochanter and then pull anteriorly.

Place a retractor (2) medial in the calcar region, proximal to the iliopsoas tendon.

If desired, place a second retractor (3) laterally at the proximal femur.

**Instruments**

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Figure 62 The insertion of the gluteus minimus, piriformis, gemellus superior, obturator internus and gemellus inferior are found at the tip of the greater trochanter and in the trochanteric fossa.
Figures 63-64 Use the Angled Curette to carefully open and sound the direction of the femoral canal.

Use a Rongeur or the Modular Box Osteotome to remove bone in the superolateral region of the neck. This step helps minimize undersizing and varus positioning of the femoral broach and stem.

Figures 65-66 The Reverse Cutting Rasp may also be used to lateralize and open the femoral canal. The Rasp operates in one direction and cuts as it is pulled out of the femur.

Ensure the Modular Box Osteotome and Reverse-Cutting Rasp are firmly attached to the handle before use. Avoid excessive or misdirected impaction or rasping motions.

*NOTE*

The Quick-Connect Handle may be attached to the Dual-offset handle to provide version control of the broaches.
The Dual-Offset Handle facilitates the introduction and alignment of the broaches.

**Figures 67-68** Using the Dual-Offset Handle, push the smallest broach into the canal. Use care to align the broach with the intended version. Only after the broach is fully introduced, begin light impaction with a mallet. Visually check for varus/valgus alignment cues such as the orientation of the handle.

**Figure 69** Keep the final broach in place to complete a trial reduction. Trialing with different heads and neck trials is performed until leg length, range of motion and hip stability are satisfactory.
**Figures 70-71** Introduce the implant by hand into the broached cavity. Using a bullet-tip stem impactor, advance the stem in a manner consistent with its respective protocol. The bullet-tip impactors are designed to swivel on the drive hole of the stem.

**Figure 72** Verify the head is secure on the trunnion after head impaction by applying traction to the head and confirming stability on the trunnion. If necessary, the head can be removed utilizing the head disassembly instrument.* Relocate the femoral head into the acetabular cup and re-check the hip biomechanics. The surgical site is then closed according to surgeon preference.

*If a ceramic head is placed on the trunnion and then removed, it must be replaced with a V40 cobalt chrome head or a V40 Titanium Adapter Sleeve (17-0000E) and a C-Taper ceramic head.
A surgeon must always rely on his or her own professional clinical judgment when deciding whether to use a particular product when treating a particular patient. Stryker does not dispense medical advice and recommends that surgeons be trained in the use of any particular product before using it in surgery.

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