Surgical Anatomy of the Hip

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The hip joint is a deep joint surrounded by large and powerful muscles necessary for its proper function. Essential neurovascular structures lie in front and in back of the hip. For man's normal daily activities the hip is perhaps the most important joint that he possesses. It is estimated that when one takes a step on the leg in normal walking, forces are transmitted across the hip approximately 2.5 times the body weight to balance the forces acting about the acetabular-femoral pivot point. It is amazing that the hip joint performs so well for so long and so uncomplainingly, in most instances. Occasionally, this mechanism develops problems requiring the surgeon's attention, and this article directs itself to these occasions.

There are many excellent texts which present the detailed anatomy and the surgical anatomy of the hip joint. This article will emphasize general principles that will be of practical help should a surgical approach to the hip become necessary.

General Principles

Always think in terms of areas, muscle function, and critical neurovascular structures. How can one safely surgically approach the hip, for whatever reason necessary, with minimal trauma to important musculo-skeletal and neurovascular structures?

The hip should always be draped free so that the leg can be moved about, unless the surgery is being done for reduction and fixation of a fracture of the femoral neck or intertrochanteric area which may require reduction, positioning, immobilization, and nailing on a fracture table. If the hip is being surgically approached for other reasons (e.g., biopsy, incision and drainage, arthrotomy, synovectomy, arthroplasty, etc), always drape the leg free as the ability to move the joint about will greatly facilitate the identification of anatomically safe and dangerous areas and allow their utilization and protection.

Dissect in line with muscle planes rather than cut across them. If it is necessary to detach muscles, do so at their tendinous insertions or bony origins (subperiosteal at origins). Retract muscles away from the hip joint toward their nerve and blood supply, thus preventing damage and assuring continued function. Always remember the general location of critical structures - the sciatic nerve (posterior), femoral nerve and vessels (anterior) - and retract these away from the hip joint with adjacent structures protecting them (muscle and soft tissues). Remember, flexing the knee and extending the hip will relax tension on the sciatic nerve and straightening the knee and flexing the hip will relax tension on the femoral nerve and vessels.

In order to employ these principles in the exposure of the hip joint, I feel it is necessary to have at least two long and gently curved Cobra retractors, as these tend to find their way instinctively around the periphery of the capsule of the hip joint, allowing protection and gentle retraction of important structures.
Front of the Hip (Anterior Approach)

**Sartorius muscle.** The sartorius muscle runs diagonally across the front of the hip from lateral (anterior superior spine) to medial (inserts medially in the upper aspect of the tibia). Its nerve supply comes in from medially (femoral); it can therefore be detached from its origin (anterior superior iliac spine) and retracted medially.

**Rectus Femoris Muscle.** The rectus femoris muscle lies over the front of the hip joint on top of the capsule and courses straight down the leg from its origin at the anterior inferior iliac spine (straight head) and anterior superior aspect of the acetabulum (reflected head). Nerve supply comes in medially and distal to the hip joint (femoral); it can therefore be detached from its origin and reflected distally and medially.

**Iliopsoas Muscle.** The iliopsoas muscle is the most powerful hip flexor. It sweeps over the pelvic brim across the front and medial aspect of the hip, forming a strong tendon which dives down below the inferior capsule and inserts into the lesser trochanter of the femur. In addition, its muscular fibers fan out and insert distally into the shaft of the femur. The neurovascular bundle (femoral nerve, artery, and vein) lies on top of this muscle beneath the sartorius muscle, and its nerve supply enters in the pelvis medially; the iliopsoas can therefore be retracted from in front of the hip joint medially along with the femoral neurovascular bundle.

**Important Points to Remember in Execution of the Anterior Approach**

Think about mobilization, protection, and retraction of the hip flexors and the femoral nerves and vessels. All are retracted medially as a general rule.

**Surgical Approach**

The patient is placed in a supine position with a small roll or towel under the sacral area on the operative side to life the hip slightly anteriorly. The hip is draped free.

An anterior incision is made, gently curving down over the anterior aspect of the iliac crest in front of the hip.

Palpate the interval between the tensor and sartorius, ie, a hand's breadth distal to the anterior superior iliac spine. Open this interval and a fatty layer will be encountered. The circumflex vessels can be felt as a leash when one passes the finger distally in this interval, and they can be ligated if a wide anterior exposure is going to be necessary. The sartorius origin can be detached from the anterior superior spine and the sartorius gently retracted medially (toward its nerve supply). The tensor origin can be subperiosteally reflected and retracted posteriorly (toward its nerve supply).

The dissecting finger can then sweep under the edge of the iliopsoas as it emerges from the pelvis, and by directing the finger posteriorly and distally beneath the anterior aspect of the hip, one can mobilize the iliopsoas and its tendon medially along with the femoral nerves and vessels. A Cobra retractor can then be inserted between the medial aspect of the hip and the iliopsoas with the femoral nerves and vessels, thus protecting them.
A Cobra retractor can similarly be placed around the superior capsule of the hip underneath the abductors through the interval identified between the tensor and sartorius, thus protecting the abductors of the hip.

The rectus femoris as it crosses the hip can be detached from the anterior inferior iliac spine and reflected distally and medially (toward its nerve supply) with or without an underlying flap of hip capsule as one prefers.

Vital structures and functional muscles are now protected, exposing the anterior aspect of the hip and the joint can be opened as widely as one desires by incision into or excision of the capsule or both.

Side of the Hip (Lateral Approach)

Tensor Muscle. The tensor muscle and fascia arises from the iliac crest, fuses with the gluteus maximus posteriorly, and courses over the lateral aspect of the hip and thigh. The nerve to the tensor comes in from behind, just below the iliac crest; the tensor can therefore be split vertically as far as necessary in its midportion (not critical from a standpoint of function) and retracted anteriorly and posteriorly as long as the vertical cut stops two fingerbreadths below the crest of the ilium (nerve will not be severed).

Gluteus Medius and Minimus. These major abductors run from the wing of the ilium and insert into the greater trochanter. The anterior edge of the abductor group (gluteus) inserts anteriorly in the greater trochanter so that its leading edge runs almost transversely in front of the hip. Don’t be fooled; this is the anterior edge of the abductors. The nerve supply and blood supply for the major abductors comes from posteriorly and superiorly; the abductors may therefore be detached at their insertion into the greater trochanter (with a portion of the trochanter to allow firm reattachment) and retracted up and back. If they do not retract easily, the piriformis and superior external rotators may be sectioned at their insertion into the trochanter with no great concern. The hip may be approached in front of or behind the abductors without detaching the trochanter by retracting the abductors and using the position of extreme external rotation (to get to the front of the hip) and internal rotation (to get to the back of the hip). This exposure, without detaching the trochanter and abductors, is more difficult, however.

Vastus Lateralis Muscle. The vastus lateralis muscle covers the lateral aspect of the femur from just below the greater trochanter distally. Its nerve supply comes from anteromedially (femoral); it can therefore be subperiosteally reflected forward and medially to expose this area of the femur as necessary. From a practical standpoint it can be split and retracted anteriorly and posteriorly, if you wish. This, in theory, might denervate and devascularize the posterior reflected portion of the muscle, but in clinical practice it seems to make no difference. Because of the anatomy, however, I prefer to retract the muscle anteriorly toward its nerve and major blood supply.
Important Points to Remember in Execution of the Lateral Approach

The abductors should be preserved, and the femoral neurovascular bundle protected as it lies in front of the hip (retracted anteromedially). The sciatic nerve must be protected as it lies posteriorly behind the hip (retract it posteromedially).

Surgical Approach

The lateral approach to the hip may be utilized when the hip is draped free as for biopsy, arthrotomy, arthroplasty, etc, or when the hip cannot be draped free as with the reduction and nailing of fracture on the fracture table. I will first discuss the lateral approach when used for the immobilized hip.

In this particular case the hip is not draped free, but a large area is blocked off with drapes after appropriate preparation. A straight incision is made over the lateral aspect of the hip, and the tensor is incised in line with its fibers. It is retracted, exposing the vastus lateralis muscle covering the upper one-third of the femur laterally. The vastus lateralis is then incised along its posterior aspect just in front of the linea aspera and subperiosteally reflected anteriorly. A Cobra or Bennett retractor is placed under this muscle to protect the posterior structures including the sciatic nerve. This exposes the upper lateral aspect of the femur, and appropriate drill holes, guide wire and nails, and/or appliances can be inserted with proper x-ray control for internal fixation of hip fractures.

Now, let us discuss the lateral approach to the hip with the leg draped free. A lateral incision is made over the trochanter of the hip, and this can be swung posteriorly, dividing the fibers of the gluteus maximus if one wishes, or slightly anteriorly in the interval between the tensor muscle where it blends with the maximus. I usually prefer the latter. This interval is opened, exposing the greater trochanter of the hip, often obscured by the trochanteric bursa which is dissected off the trochanter so that one can better identify the structures. A Cobra retractor is then placed posterior to the hip around the inferior aspect of the capsule through the external rotators, and this protects the sciatic nerve posteriorly. The examining finger then slides along the anterior aspect of the hip under the brim of the pelvis beneath the flexors, femoral vessels and nerves, and a Cobra retractor is inserted here and gently retracted to protect these anterior structures. The greater trochanter can then be osteotomized and reflected superiorly with the attached abductor muscles, incising the insertion of the piriformis and upper external rotators into the trochanter posteriorly, if necessary, to mobilize the trochanter. The trochanter, with its abductors, is then retracted superiorly exposing the underlying capsule. Vital structures are protected by the various retractors. The capsule can then be opened and/or excised and the hip further inspected as necessary.

Back of Hip (Posterior Approach)

The posterior aspect of the hip is covered superficially by the gluteus maximus. It can be split in line with its fibers as its nerve and blood supply arborize medially from its undersurface. Split the maximus in the lower one-third if possible.

Sciatic Nerve. The sciatic nerve is in the layer of fat between the gluteus maximus and the external rotators of the hip. To locate this layer, punch a Kelly or other clamp through
the substance of the gluteus maximus, open this hole by opening the clamp, separate the
muscles with your fingers, and the fatty layer will appear underneath the gluteus maximus.
The sciatic nerve lies in this layer and can be palpated here with the examining finger and
retracted posteriorly and medially away from the hip joint. Retracting it in this direction
decreases the stretch on the nerve, as do flexing the knee and extending the hip.

**External Rotators.** The external rotators lie across the back of the hip in close
relation to the posterior capsule. These may be cut at their insertion into the femur and greater
trochanter and retracted posteriorly and medially (toward their nerve and blood supply).

**Important Points to Remember in Execution of the Posterior Approach**

Think about identification, protection and retraction of the sciatic nerve which lies
underneath the maximus and on top of the external rotators.

**Surgical Approach**

The patient is placed on the opposite side and turned forward about 30 degrees. The
hip and leg are draped free. An incision is made along the inferior border of the gluteus
maximus in line with its fibers, and this may be extended down the side of the hip into the
tensor fascia area if a wide exposure is necessary. The gluteus maximus fibers are split, and
the fatty layer beneath the gluteus is identified and the sciatic nerve palpated with the finger.
The nerve is always retracted gently posteriorly and medially to protect it. The gluteus
maximus is then further split distally down into the tensor fascia area, if necessary. A Cobra
retractor can then be placed around the superior aspect of the hip capsule beneath the
abductors, thereby protecting them. A second Cobra is placed inferiorly underneath the
capsule through the substance of the external rotators, exposing the external rotators overlying
the posterior capsule of the hip at that level. The external rotators are then incised at their
insertion into the trochanteric area of the hip and are retracted medially toward their nerve
supply, thereby exposing the posterior capsule of the hip. The capsule can then be incised for
exposure of the hip joint itself.

**Medial Approach to the Hip**

The medial aspect of the hip may be approached by going through the adductor area.
This approach is rarely used by the general surgeon or orthopedist. It allows one to get down
to the area of the lesser trochanter for biopsy and/or release of the psoas tendon at its
insertion. It allows only limited access to the hip, and then with difficulty.

If one elects to use this approach, the patient is placed supine with the hip and leg
draped completely free. The leg is flexed and externally rotated. A linear incision is made
over the aspect of the thigh in line with the adductor muscles. The interval between the
adductor brevis and longus anteriorly with the adductor magnus posteriorly is bluntly
separated with a clamp, retracting the adductor brevis and longus forward and the adductor
magnus posteriorly, and the femur is palpated with the examining finger. Two Cobra
retractors are placed subperiostally about the femur, retracting the vital structures forward
and backward. This exposes the area of the lesser trochanter, the insertion of the iliopsoas
tendon, and the distal inferior capsule of the hip joint. Exposure is limited, making this
approach best reserved for biopsy of the area of the lesser trochanter and/or release of the iliopsoas tendon.

**Philosophy**

In studying hip surgery under Doctor Otto E. Aufrane, an internationally known hip surgeon, at the Massachusetts General Hospital, I learned to respect and follow the following principles. Handle all tissues gently; release traction frequently to restore intermittent blood supply; and always keep in mind where the critical vital structures are or should be. Appreciate the fact that a previously operated hip's anatomy may be different from normal. Study the problem and be thinking of it far in advance of the surgical procedure. Considerable thought and reflection on the problem will pay off at the time of surgery. These principles have superbly withstood the test of clinical application.

**Conclusion**

The principles taught in this particular article are simply broad ideas and generalities that should be kept in mind. This paper does not purport to be a substitute for detailed and thorough review of the specific approach that one selects when exposing the hip joint. Heeding these principles, however, may reduce the possible problems that one might encounter in surgically investigating this interesting and deeply situated joint.