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ESSENTIAL SURGICAL TECHNIQUES

SUBSPECIALTY PROCEDURES

The Kocher-Langenbeck Approach

State of the Art

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Introduction

The Kocher-Langenbeck approach is the workhorse for the reduction and fixation of hip fractures that require fixation via a posterior approach[1,2]. It provides direct access to the outer surface of the posterior column and posterior wall and indirect access to the superior wall and quadrilateral surface. This is accomplished through the splitting of the muscle fibers of the gluteus maximus and the release of its tendinous femoral insertion along with the release of the piriformis and the short external rotators from their femoral insertion at the piriformis fossa. Delicate release and handling of the muscles attached to the greater trochanter are of paramount importance in order to protect the medial femoral circumflex artery. In posterior wall fractures, direct visualization of the articular surface of the acetabulum and femoral head is possible through the fracture lines and careful manipulation of the fracture fragments. Whenever possible, the labrum should not be detached from the acetabular rim. The retroacetabular surface, the ischial spine, and the greater and lesser sciatic notches can be adequately visualized with the Kocher-Langenbeck approach. The quadrilateral surface can be digitally palpated with the surgeon's index finger via the greater sciatic notch. Despite the fact that the Kocher-Langenbeck approach offers a wide access to the posterior elements of the acetabulum, the surgeon must remain cognizant that this approach is not extensile and whenever a wider exposure is needed, e.g., in superior dome involvement, a different approach might be considered[3]. Although some surgeons perform the Kocher-Langenbeck approach with the patient in the lateral position, in our institution we routinely utilize the prone position. Skeletal traction through the distal end of the ipsilateral femur is also routinely used. Regardless of the prone or lateral position used for the approach, the sciatic nerve should be relaxed at all times. Hip extension and knee flexion help to avoid undue tension to the sciatic nerve.

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Indications & Contraindications

Indications

- Posterior wall acetabular fractures (Video 1).
- Posterior column acetabular fractures.
- Posterior column and posterior wall acetabular fractures.
- Transverse and posterior wall acetabular fractures.
- Transverse acetabular fractures with the major displacement occurring at the posterior column.
- Posterior element reduction and fixation in T-type acetabular fractures.

Contraindications

- Anterior wall acetabular fractures.
- Anterior column acetabular fractures.
- Transverse acetabular fractures with the major displacement occurring at the anterior column.
- Associated both-column acetabular fractures.
- Anterior element reduction and fixation in T-type acetabular fractures.
- Anterior column and posterior hemitransverse acetabular fractures.
- Anterior column and anterior wall acetabular fractures.

Video 1 Indications and contraindications for the Kocher-Langenbeck approach as well as preoperative imaging studies and planning.

Step 1: Preoperative Planning

Review the patient's general condition and imaging studies, plan the sequence of reduction and fixation, and make sure that all of the necessary equipment is available.

- Surgery for acetabular fractures typically occurs 3 to 5 days after injury.
- Review the patient's general condition and review the events surrounding the traumatic injury; the pertinent medical, surgical, social, and family history; and the results of a complete physical examination.
- Use intraoperative autologous blood transfusion (cell salvage).
- Review the imaging studies (anteroposterior pelvic and Judet oblique acetabular radiographic views and computed tomography [CT] images).
- Plan the sequence of reduction and fixation in a dry bone model.
- Make sure that the appropriate operating table, instruments, and implants are available. For acetabular fracture reduction, specialized reduction tools, such as pelvic reduction clamps and forceps, ball spike pushers, and bone hooks, are used. For fracture fixation, 3.5-mm cortical screws and 3.5-mm reconstruction plates are commonly used. Other implants that might be necessary, depending on the fracture type, are the one-third tubular plates (used as spring plates) and the 2.0-mm miniscrews (used for the 2-level reconstruction of marginal impaction of the posterior wall).

Step 2: Preparation and Patient Positioning

Induce anesthesia, administer intravenous antibiotics as per local hospital protocol, apply antiembolism stockings, and insert a Foley catheter to the bladder.

- Use the World Health Organization (WHO) Surgical Safety Checklist.
- Make sure that all of the appropriate imaging studies (radiographs and CT scans) are displayed.
- Induce anesthesia.
- Administer intravenous antibiotics as per local hospital protocol.
- Apply antiembolism stockings and insert a Foley catheter to the bladder.
- Under sterile conditions, apply ipsilateral distal femoral skeletal traction.
- Position the patient prone on the fracture table (ProFx; Mizuho OSI) with a perineal post. Make sure that all of the osseous prominences are well padded. Chest rolls that allow for free abdominal movements are used. We prefer the prone position for the Kocher-Langenbeck approach because it (1) allows for controlled traction of the limb, (2) facilitates easier positioning of the femoral head under the intact acetabular dome, (3) makes the quadrilateral surface easier to palpate, and (4) makes the application of clamps through the greater sciatic notch easier. Recent studies[4-6] have shown that, for transverse acetabular fractures, the use of the prone position is associated with a trend toward improved reduction compared with lateral positioning. This effect is probably more evident in patients with an infratectal or juxtatectal type of transverse fracture because of the fact that the reduction is not hindered by the weight of the leg, which occurs in the lateral position. In transverse and T-type fractures, the femoral head tends to keep the acetabular fracture surfaces apart because of gravity, thus creating difficulties in reduction.
- The disadvantages of the prone position are that (1) it does not allow for extension of the incision, i.e., the trochanteric flip osteotomy is not possible; (2) it does not offer great maneuverability of the lower extremity; and (3) it might be disorientating for surgeons who have routinely used the lateral position. We prefer the lateral position in the following cases: (1) when the physiology of the patient does not allow for prone positioning, (2) when a trochanteric osteotomy is anticipated to address posterior-superior wall fractures, and (3) in the context of femoral head and acetabular fractures (Pipkin type-IV fractures) when a surgical hip dislocation is necessary.
- Make sure that the ipsilateral knee is flexed to 80° to 90° and no undue tension is applied to the sciatic nerve.
- Bring the C-arm image intensifier from the contralateral side and ensure that all of the necessary fluoroscopic views can be acquired.
- In preparing the surgical field, ensure that the gluteal cleft is covered and isolated and that the lateral and posterior aspects of the proximal part of the femur are easily accessible.
- Apply traction through the distal end of the femur.
- Understand the new fragment position after traction application (Video 2) and maintain traction only for the time period that is needed (be mindful of traction neurapraxia).

Video 2 Patient positioning.

Step 3: Kocher-Langenbeck Approach

Make an incision that is 15 to 20 cm long and has 2 parts (proximal and distal), which are centered over the greater trochanter.

- The palpable osseous landmarks of the Kocher-Langenbeck approach are the greater trochanter and the posterior superior iliac spine (PSIS).
- The distal part of the incision is in line with the longitudinal axis of the femur and starts 10 to 15 cm distal to the tip of the greater trochanter.
- Start the proximal part of the incision at the tip of the greater trochanter and direct it toward the PSIS, ending 6 cm short of this landmark.
- After the subcutaneous fat is incised, the iliotibial band is encountered. Take care not to compromise the gluteus maximus tendinous insertion. After dissection through the distal part of the trochanteric bursa, the surgeon palpates the undersurface of the gluteus maximus muscle with his or her index finger and identifies the raphe, which separates the upper one-third from the lower two-thirds of the muscle (which have a different vascular supply: the superior gluteal artery for the upper one-third and the inferior gluteal artery for the lower two-thirds). The dissection then proceeds in this intervascular interval (Video 3).
- Identify and partially or fully release the gluteus maximus insertion at the femoral shaft. A safe technique of releasing the gluteus maximus tendon and protecting the first perforating branch of the profunda femoris artery is to perform a soft-tissue expansion by bluntly advancing a Cobb retractor between these structures, separating the muscle from the artery. Tag the insertion of the tendon with a suture and release 1.5 cm from the bone while maintaining the Cobb retractor in place, thus protecting the artery[7].
- Use a Charnley retractor to provide access to the underlying structures.
- Identify the sciatic nerve. The safest place to initially identify this structure is over the posterior surface of the quadratus femoris muscle. The identification of the sciatic nerve more proximally is unsafe because of the potentially distorted anatomy due to the fracture and/or trauma and should consequently be avoided. Handle the sciatic nerve gently, avoiding excessive release of the surrounding fat tissue, and follow it up to the greater sciatic notch. Awareness of the nerve position and tension or compression applied to it at any given time throughout the procedure is of paramount importance (Video 4).
- Identify the tendons of the piriformis and the gemelli muscles. The tendon of the obturator internus muscle is not initially visible because it is located anterior to the gemelli tendons. Release the tendon of the piriformis muscle 1.5 cm from its femoral insertion and tag it with a suture. Develop the interval between the superior aspect of the quadratus femoris muscle and the conjoined tendon (gemelli and obturator internus) with blunt dissection. Exercise care to avoid injury of the ascending branch of the medial circumflex femoral artery, which lies close to the tendinous insertions of the muscles. The hip capsule is separated from the conjoined tendon using a blunt instrument. The tendon is tagged and released 1.5 cm from its femoral insertion. Take care to ensure that the obturator internus tendon is captured with the tagged suture because the undersurface of this structure needs to be followed medially to identify the lesser sciatic notch (Videos 5 and 6).

Video 3 Superficial dissection.

Video 4 Gluteus maximus dissection and identification of the sciatic nerve.

Video 5 Piriformis identification and release.

Video 6 Obturator internus and gemelli identification and release.

- Elevate the gluteus minimus off the underlying bone (retroacetabular surface) from distal to proximal. The proximal dissection at this stage is limited by the superior gluteal neurovascular structure, which needs to be protected. The superior gluteal neurovascular bundle is exiting the greater sciatic notch superior to the level of the sciatic nerve and is identified with palpation of the superior gluteal artery. Be vigilant at all times to avoid injury to this structure, which can happen by direct laceration or undue traction of the abductors. Inspect the fracture fragments. The femoral head can be inspected after careful handling of the posterior wall, and intra-articular fragments and debris can be removed after gentle traction (Video 7).
- It should be noted that great anatomical variability of the area exists, especially in relation to the piriformis muscle and the sciatic nerve[8,9]. In the most common variation, an unsplit sciatic nerve passes distal to the unsplit fibers of the piriformis muscle. In the second most common variation, the nerve separates into 2 divisions above the piriformis; 1 branch passes through the piriformis fibers, and the other below the muscle. Less commonly, the nerve separates into 2 divisions above the piriformis; 1 branch passes above the muscle, the other passes below the muscle. External rotation relaxes the muscles, while internal rotation puts them in tension (Video 8).
- At this stage, the dissection needed for most of the posterior fracture patterns is complete. To achieve access to the quadrilateral surface, carefully detach the obturator internus from the inner table of the greater sciatic notch. Detachment of the sacrospinous ligament and osteotomy of the ischial spine is very rarely performed and could provide wider access. The access provided is tactile through one's index finger. Visual access to the quadrilateral surface is impossible through the Kocher-Langenbeck approach.

Video 7 Fracture identification.
Video 8 Surgical anatomy demonstration.

Step 4: Fracture Reduction and Fixation

The reconstruction of posteriorly based fractures depends on the specific fracture type, and the goal is to provide stable column fixation and anatomical reconstruction of the acetabular articular surface, with column fixation performed before the reconstruction of the posterior wall.

- Carefully debride the edges of the fracture fragments before performing any reconstruction maneuvers. The reconstruction of the acetabular articular surface is indirect when the Kocher-Langenbeck approach is used and relies on good-quality cortical reductions of the retroacetabular surface.
- Manipulation of the anterior column in transverse or T-type fractures is difficult, but can be accomplished via a clamp through the greater sciatic notch, taking care to avoid injury of the intrapelvic structures.
- Reduce the posterior column using clamps, bone hooks, and joysticks, taking into account its 3-dimensional displacement. Stabilize the reduction with a reconstruction plate properly contoured (overbent or underbent) according to the fracture type or lag screws from the posterior column to the intact ilium. Position the plate to be applied to the posterior column, taking care not to impede the placement of the second posterior wall plate in cases in which this is anticipated. In patients with extension of the fracture fragments proximally, identify the superior gluteal artery as previously described and place the plate under it.
- Visualization of the femoral head and acetabular surface is provided through the posterior wall fragment. The labrum, whenever possible, should be respected. The 2-level reconstruction of marginal impaction[10-12] takes place prior to posterior wall reconstruction. Reduce and stabilize the posterior wall using ball-spiked pushers and Kirschner wires.
- Use one or two 3.5-mm lag (by mode) screws for the fixation of the posterior wall fragment. These screws can be inserted either independently or through the plate.

- The posterior wall plate spans from the ischial tuberosity to the retroacetabular surface. Apply a 3.5-mm reconstruction plate in a buttress mode.

Step 5: Wound Closure and Postoperative Care

Meticulous hemostasis, application of drains, and watertight closure are the final steps of the operation.

- One of the complications of the Kocher-Langenbeck approach is the development of heterotopic ossification[13,14]. To minimize the risk of this complication, meticulously debride any dead soft tissues. Direct one's attention toward the gluteus minimus insertion area and debride dead muscle debris. We have observed that when the operative time is prolonged, the areas of the gluteus maximum muscle directly in contact with the Charnley retractor become devitalized and should be subsequently removed.
- Insert a drain through the upper part of the gluteus maximus muscle.
- Reattachment of the gluteus maximus tendon depends on the degree of the initial release. If reattachment is performed, use an interrupted number 1-0 Vicryl suture (polyglactin; Ethicon).
- Reattach the piriformis and conjoined tendons to their femoral stump footprint using a number 1-0 Vicryl suture (Video 9).
- Close the subcutaneous tissue and the skin with number 2-0 Vicryl suture and staples, respectively.
- Prescribe pharmacological thromboprophylaxis for 6 to 8 weeks.
- We use prophylaxis against heterotopic ossification in patients who have a double (anterior and posterior) or extensile iliofemoral approach as well as when reconstruction is delayed (>2 weeks).
- Instruct the patient to take universal hip precautions if posterior wall reconstruction has been done.
- Have the patient start physical therapy with isometric quadriceps and abductor strengthening exercises on the first postoperative day.
- Instruct the patient to use toe-touch weight-bearing for 8 to 12 weeks.
- Have the patient return for clinical and radiographic follow-up at 2 and 6 weeks and then at 3, 6, 12, and 24 months postoperatively.

Video 9 Reattachment of muscles and closure.

Results

The Kocher-Langenbeck approach is the workhorse for the surgical management of acetabular fractures and provides sufficient access to the majority of posterior based acetabular fractures[15]. In a recent study that reported on the survivorship of the hip in 810 patients with operatively treated acetabular fractures, the Kocher-Langenbeck approach was used in 43% of the cases[16]. The outcome of the surgical management of acetabular fractures is multifactorial[16], and it has been reported that the fracture type, sex, and age are prognostic factors for the outcome after open reduction and internal fixation using the Kocher-Langenbeck approach[17].

Pitfalls & Challenges

- Avoid excessive traction.
- Make sure that the horizontal limb of the incision is not too posterior. This will help to prevent accidental injury to the sciatic nerve when the fascia is incised distally.
- Make sure that the piriformis and conjoined tendons are released from their trochanteric insertion without compromising the vascular supply of the femoral head.
- Dissect very carefully at the supra-acetabular area to avoid injury to the gluteal neurovascular bundle.
- Avoid dissection close to the acetabular rim in order to preserve its vascular supply.
- Always identify the lesser sciatic notch. This is a safe area for sciatic nerve retractor placement.

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