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CHAPTER 10.4

Hip, Pelvis, Upper Leg Surgery

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Open Reduction and Internal Fixation (ORIF) of Pelvis or Acetabulum

Surgical Considerations

Description: Pelvic fractures present several challenging treatment problems. Surgical management is complex and often difficult in nature. Specialized training and equipment are required for a successful outcome. Major trauma mechanisms produce pelvic-ring injuries, and patients with pelvic-ring disruptions frequently have associated systemic injuries, which may be life-threatening (e.g., hemorrhagic shock). Pelvic stabilization and surgical control of hemorrhage may be performed acutely in the polytrauma patient who is hemodynamically unstable. This is in conjunction with an exploratory laparotomy performed by a trauma surgeon. The majority of patients with pelvic fractures who are treated operatively are taken to the OR on a delayed basis, after they have been stabilized. Pelvic fractures that do not heal are “nonunions,” whereas those that heal in an unsatisfactory position are “malunions.”

Anterior approaches to the pelvis include Pfannenstiel's and ilioinguinal incisions, which are utilized for reduction and fixation of dislocations and fracture/dislocations of the symphysis pubis, fractures of the pubic rami, and access to the anterior aspect of the sacroiliac (SI) joint. **Posterior approaches** to the pelvis involve either vertical or curved incisions along the iliac crest and are used for reduction and fixation of SI joint dislocations, fracture/dislocations of the SI joint, and fractures of the iliac wing and of the sacrum. These procedures are often lengthy and are staged, requiring changes in patient position. Reductions are facilitated by neuromuscular paralysis. The posterior approach requires a large operative field, which may prevent the use of an epidural catheter. In addition, postop anticoagulation for DVT prophylaxis is used uniformly, and may contraindicate the use of epidural catheters. The goal of pelvic reconstruction is to restore the anatomy and stability of the pelvis, which will decrease hemorrhage in the hemodynamically unstable patient, aid in mobilization of the multiply injured patient; and improve long-term function.

Usual preop diagnosis: Fractures of pelvis/acetabulum; nonunion/malunion of the pelvis/acetabulum

Summary of Procedures

Position	Supine (anterior); prone (posterior)
Incision	Pfannenstiel's, ilioinguinal (anterior); posterior, curving along iliac crest (posterior)
Special instrumentation	Radiolucent table; pelvic instruments and implants; Cell Saver; I.I.
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)
Surgical time	1–6 h (anterior); 3–6 h (posterior)
Closing considerations	May require neuromuscular relaxation to aid reduction and closure; postop radiograph
EBL	≥ 1,000 mL
Postop care	Multiple-trauma patient → ICU; others → PACU
Mortality	10%+, dependent on extent of multiple trauma Ileus: Common Neurologic injury: Common

Morbidity	Genitourinary injuries: Not uncommon Failure of fixation: Rare Infection: Rare Malunion: Rare Nonunion: Rare
Pain score	9

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Patient Population Characteristics

Age range	Any age, but predominance of males < 30 yr
Male:Female	5:1
Incidence	1–2%
Etiology	Motorcycle and motor vehicle accidents (60–80%); falls (10–15%); crush injuries (5%); other (5%)
Associated conditions	Frequently associated with trauma to other organ systems, including head and neck, chest, abdomen, and extremities. These often will be addressed concurrently with pelvic or acetabular fracture.

Anesthetic Considerations

See Anesthetic Considerations for Procedures about the Pelvis and Hip (p. 989).

Suggested Readings

1. Burgess AR, Jones AL: Fractures of the pelvic ring. In *Fractures in Adults,* 4th edition. Rockwood CA Jr, Green DP, Bucholz RW, et al., eds. Lippincott-Raven, Philadelphia: 1996, 1575–1616.

2. Fishmann AJ, Greeno RA, Brooks LR, et al: Prevention of deep vein thrombosis and pulmonary embolism in acetabular and pelvic fracture surgery. *Clin Orthop* 1994; 305:133–7.

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5. Kane WJ: Complications of pelvic fractures and their treatment. In *Complications in Orthopaedic Surgery.* Epps CH Jr, ed. JB Lippincott, Philadelphia: 1986, 795–814.

6. LaVelle DG: Delayed union and nonunion of fractures. In *Campbell's Operative Orthopaedics,* 10th edition. Canale ST, ed. CV Mosby, St. Louis: 2003, 3125–67.

7. Leighton RK: Nonunions and malunions of the pelvis. In *Chapman's Orthopaedic Surgery,* Vol I, 3rd edition. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 921–34.

8. Mears DC, Durbhakula SM: Fractures and dislocations of the pelvic ring. In *Chapman's Orthopaedic Surgery,* Vol I, 3rd edition. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 531–86.

9. Mears DC, Rubash HE: *Pelvic and Acetabular Injuries.* Slack Inc., Thorofare NJ: 1986.

10. Prevezas N: Evolution of pelvic and acetabular surgery from ancient to modern times. *Injury* 2007; 38(4):397–409.

11. Rice PL Jr, Rudolph M:. Pelvic fractures. *Emerg Med Clin North Am* 2007; 25(3):795–802.

12. Tile M: Fractures of the acetabulum. In *Fractures in Adults,* 4th edition. Rockwood CA Jr, Green DP, Bucholz RW, et al., eds. Lippincott-Raven, Philadelphia 1996, 1617–58.

13. Tile M: *Fractures of the Pelvis and Acetabulum,* 2nd edition. Williams & Wilkins, Baltimore: 1995, 549–54.

Closed Reduction and External Fixation of the Pelvis

Surgical Considerations

Description: This procedure entails manipulating the pelvis to obtain an acceptable reduction by closed means under GA, and then applying an anterior external fixation device to maintain the reduction. The pins for the external fixator are inserted into the iliac crest either percutaneously or through small incisions. During this procedure, either radiographs or the I.I. is used to confirm that an acceptable reduction has been obtained. In some centers, this procedure is done in the emergency department as a life-saving procedure.

Usual preop diagnosis: Displaced fracture of the pelvis; unstable fracture of the pelvis

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Summary of Procedures

Position	Supine
Incision	Percutaneously or through small incisions along the iliac crest.
Special instrumentation	External fixation; often performed on a radiolucent table using I.I.
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic); Combination antibiotics, if multiple severe, open fractures or other significant injuries are present.
Surgical time	1–1.5 h
EBL	Negligible from surgical procedure; however, anticipate large blood losses (4+ U) from the pelvic fracture alone.
Postop care	Multiple-trauma victim → ICU; others → PACU
Mortality	10% or more, depending on extent of multiple trauma; 50% in open fractures
Morbidity	Ileus: Virtually 100%; Sacroiliac (SI) pain: 15–30%+ Genitourinary problems, including bladder or urethral rupture: 13% Neurological deficit to lumbosacral plexus: 1–10% Malunion/severe deformity: 5% Leg-length discrepancy: 3–5% Impotence: 1–5% Residual instability: 1–3% Vascular complications: 1% Hypotension 2° to retroperitoneal hematoma: Common

	Respiratory distress: Common Gynecological and colorectal injuries: More common with open fractures/dislocations Delayed union, nonunion: Not uncommon Osteomyelitis: Rare Rupture of diaphragm: Rare
Pain score	7–10

Patient Population Characteristics

Age range	Any age, but predominance of males < 30 yr
Male:Female	5:1
Incidence	Common
Etiology	Motorcycle and motor vehicle accidents (60–80%); falls (10–15%); crush injuries (5%); other (5%)
Associated conditions	Frequently associated with trauma to other organ systems, including head and neck, chest, abdomen, and extremities. Patient sustaining a pelvic fracture also has a probability of having other injuries, including: musculoskeletal (85%); respiratory (60%); CNS (40%); GI (30%); urologic (12%); CVS (6%). These often will be addressed concurrently with the pelvic fracture.

Anesthetic Considerations

See Anesthetic Considerations for Procedures about the Pelvis and Hip (p. 989).

Suggested Readings

1. Bucholz RW, Brumback RJ: Fractures of the shaft of the femur. In *Fractures in Adults,* 4th edition. Rockwood CA Jr, Green DP, Bucholz RW, et al., eds. JB Lippincott, Philadelphia: 1996, 1827–1918.

2. Guyton JL: Fractures of hip, acetabulum, and pelvis. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. Mosby-Year Book, St. Louis: 1998, 2042–80.

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3. Jones A, Reinert C, Bucholtz R: Complications of fractures of the pelvic ring and acetabulum. In *Complications in Orthopaedic Surgery,* 3rd edition. Epps CH Jr, ed. JB Lippincott, Philadelphia: 1994, 749–62.

4. Kane WJ: Complications of pelvic fractures and their treatment. In *Complications in Orthopaedic Surgery.* Epps CH Jr, ed. JB Lippincott, Philadelphia: 1986, 795–814.

5. Mears DC, Durbhakula: Fractures and dislocations of the pelvic ring. In *Chapman's Orthopaedic Surgery,* Vol I, 3rd edition. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 531–86.

6. Mears DC, Rubash HE: *Pelvic and Acetabular Injuries.* Slack Inc, Thorofare NJ: 1986.

7. Prevezas N: Evolution of pelvic and acetabular surgery from ancient to modern times. *Injury* 2007; 38(4):397–409.

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9. Tile M: *Fractures of the Pelvis and Acetabulum,* 2nd edition. Williams & Wilkins, Baltimore: 1995, 549–54.

Open Reduction and Internal Fixation (ORIF) Of Acetabulum Fractures

Surgical Considerations

Description: Although the acetabulum is contained within the bony architecture of the pelvis, surgical management of acetabulum fractures are approached separately from pelvic fractures. The goal of surgical treatment of acetabulum fractures is to preserve the hip joint by accurately reconstructing the supporting bony anatomy. Surgical treatments of these challenging injuries are performed by surgeons who have undergone specialized training in orthopedic pelvic surgery. The mechanism of injury is usually high-energy trauma (e.g., motor vehicle, motorcycle accidents), industrial accidents, or a fall from a height that drives the femur into the acetabulum. Associated injuries to the pelvis are common, as are associated systemic injuries.

Optimal results are achieved when surgery is performed within 7 d. The approach is dictated mainly by the unique characteristics of the fractures. Essentially, three approaches are commonly used: the **ilioinguinal** (anterior, Fig. 10.4-1), the **extended iliofemoral** (lateral, Fig. 10.4-2), and the **Kocher-Langenbeck** (posterior, Fig. 10.4-3). The most difficult portion of the procedure is the reduction; it may be facilitated by neuromuscular relaxation, pelvic reduction instruments, and traction. The I.I. is used frequently throughout the procedure to assess the reduction and position of implants, which necessitates the use of lead aprons. A radiograph also is obtained at the end of the case to verify a satisfactory reduction and position of the implants. Patients are anticoagulated in the postop period to prevent thromboembolic complications. Weight-bearing restrictions are maintained until enough healing has occurred to permit functional ambulation.

Usual preop diagnosis: Fracture of the acetabulum; nonunion/malunion of the acetabulum

Summary of Procedures

Position	Supine (anterior); lateral decubitus (lateral); prone (posterior)
Incision	Ilioinguinal (anterior, Fig. 10.4-1); extended iliofemoral (lateral, Fig. 10.4-2), Kocher-Langenbeck (posterior, Fig. 10.4-3)
Special instrumentation	Pelvic table; pelvic instruments and implants; I.I.; Cell Saver
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)
Surgical time	2–5 h
EBL	100–2,000 mL
Postop care	Multiple-trauma: ICU; others: PACU
Mortality	2.28%
Morbidity	Ectopic ossification: 24.4% Osteoarthritis after perfect reduction: 10.2%; after imperfect reduction: 35.7% Injury to lateral cutaneous nerve of the thigh: 12% Sciatic nerve damage: 6.3% Infection: 4.2% Avascular bone necrosis: 4.1% DVT: 3% Wound hematoma: 1.5% Secondary displacement of fracture site: 1.5% PE: 1% Pseudoarthrosis: 0.7% Ileus after ilioinguinal approach: Common
Pain score	7–8

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Patient Population Characteristics

Age range	12–85 yr
Male:Female	65.6% (M); 34.6% (F)
Etiology	Motor vehicle accidents (70%); motor vehicle/pedestrian accidents (13%); falls (14%); other (3%)

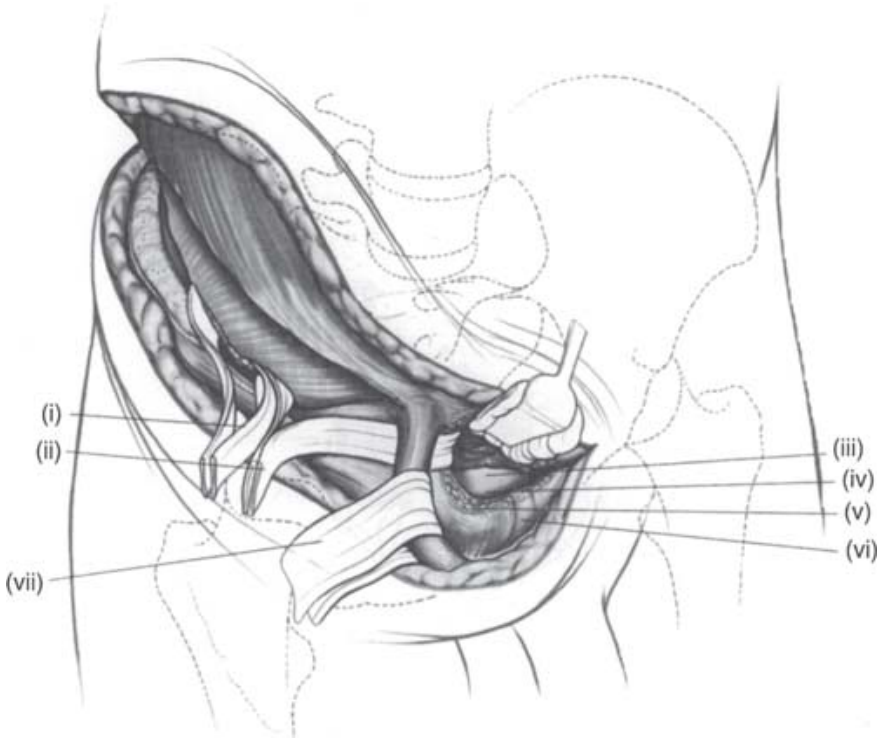

Figure 10.4-1. 1. Ilioinguinal approach, right side: (i) Penrose drain around iliopsoas, femoral nerve, and lateral femoral cutaneous nerve; (ii) Penrose drain around femoral vessels; (iii) bladder and space of Retzius; (iv) pubis; (v) pubic tubercle; (vi) symphysis pubis; (vii) Penrose drain around spermatic cord. (Reproduced with permission from Sledge CB, ed: *The Hip.* Lippincott-Raven: 1998.)

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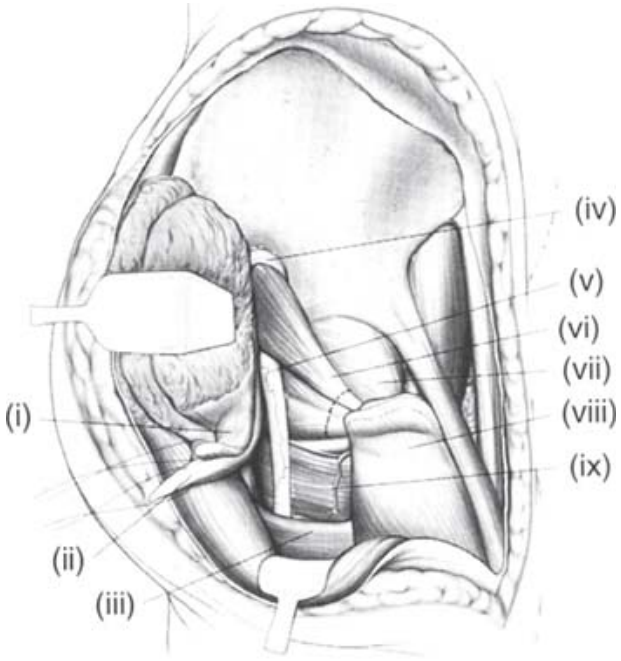

Figure 10.4-2. 2. Extended iliofemoral approach: (i) Gluteus minimus tendon; (ii) gluteus medius tendon; (iii) gluteus maximus tendon; (iv) superior gluteal neurovascular bundle; (v) sciatic nerve; (vi) piriformis and conjoint tendons; (vii) hip joint capsule; (viii) greater trochanter; (ix) medial femoral circumflex artery overlying quadratus femoris. (Reproduced with permission from Sledge CB, ed: *The Hip*. Lippincott-Raven: 1998.)

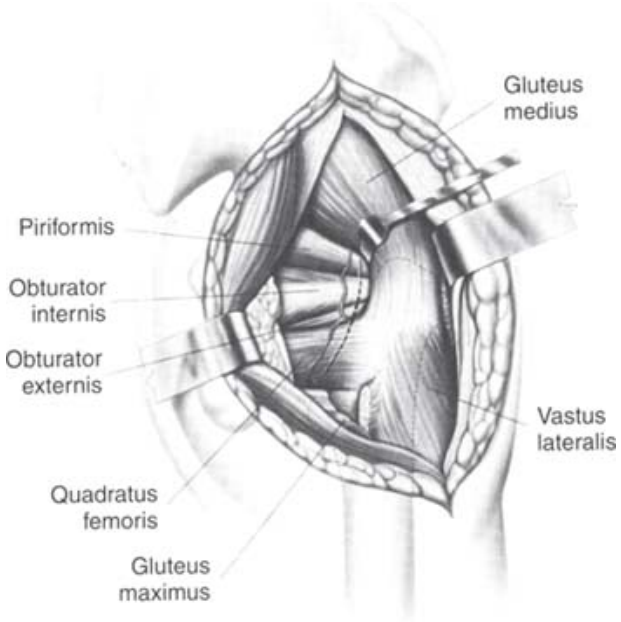

Figure 10.4-3. 3. Kocher-Langenbeck approach. (Reproduced with permission from Sledge CB, ed: *The Hip.* Lippincott-Raven: 1998.)

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Anesthetic Considerations

See Anesthetic Considerations for Procedures about the Pelvis and Hip, p. 989.

Suggested Readings

1. Fishmann AJ, Greeno RA, Brooks LR, et al: Prevention of deep vein thrombosis and pulmonary embolism in acetabular and pelvic fracture surgery. *Clin Orthop* 1994; 305:133–7.

2. Johnson EE, Matta JM, Mast JW, et al: Delayed reconstruction of acetabular fractures 21–120 days following injury. *Clin Orthop* 1994; 305:20–30.

3. Letournel E, Judet R: *Fractures of the Acetabulum*. Spring, New York: 1993.

4. Matta JM: Fractures of the acetabulum: reduction accuracy and clinical results of fractures operated within three weeks of injury. *J Bone Joint Surg* 1996; 78A:1632–45.

5. Olson SA, Matta JM: Fractures of the acetabulum, hip dislocations, and femoral head fractures. In *Chapman's Orthopaedic Surgery,* Vol I, 3rd edition. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 587–616.

6. Prevezas N: Evolution of pelvic and acetabular surgery from ancient to modern times. *Injury* 2007; 38(4):397–409.

7. Rice PL Jr, Rudolph M: Pelvic fractures. *Emerg Med Clin North Am* 2007; 25(3):795–802.

Osteotomy and Bone Graft Augmentation of the Pelvis

Surgical Considerations

Description: Acetabular insufficiency (acetabular dysplasia) is characterized by deficient anterior and lateral coverage of the acetabulum on the femoral head. This condition of the hip produces joint incongruity and instability, eventually leading to arthrosis and a dysfunctional hip joint. Treatment is aimed at reorienting the dysplastic acetabulum (Fig. 10.4-4). In children, bone grafting alone may be sufficient; in adults, however, pelvic osteotomy, to reorient or broaden the weight-bearing surface, is necessary. A supplemental bone graft to expand the weight-bearing surface may be added. In certain instances following pelvic osteotomy, incongruity of the hip may persist. In this situation, the pelvic osteotomy is combined with a proximal femoral osteotomy to restore congruence. Pelvic and proximal femoral osteotomies usually are fixed internally with screws and plates to allow early mobilization without displacement. Weight-bearing is permitted after healing of the osteotomy at 8 wk.

Usual preop diagnosis: Acetabular dysplasia; developmental dysplasia of the hip

Summary of Procedures

Position	Supine
Incision	Anterior: ilioinguinal or iliofemoral and Smith-Peterson
Special instrumentation	Pelvic instruments and implants; special osteotomes and saws; I.I., Cell Saver
Unique considerations	Intraop radiographs and use of I.I.
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)
Surgical time	3 h
EBL	500+ mL
Postop care	PACU → room; usually on protected, weight-bearing walker or crutches × 8 wk
Mortality	Minimal

Morbidity	Ileus: 100% Leg-length discrepancy: Uniformly present after pelvic osteotomy Injury to lateral cutaneous nerve: Common (50%) Sciatic nerve: Uncommon (1%) Thromboembolism: 5–10% Wound infection: 1–5% Septic arthritis, osteomyelitis: 1–7% Delayed union, nonunion, malunion: 1–2% Genitourinary problems—urinary retention requiring catheterization: Common Hematoma: Common Hypotension 2° to retroperitoneal hematoma: Rare Vascular complications: Rare
Pain score	8

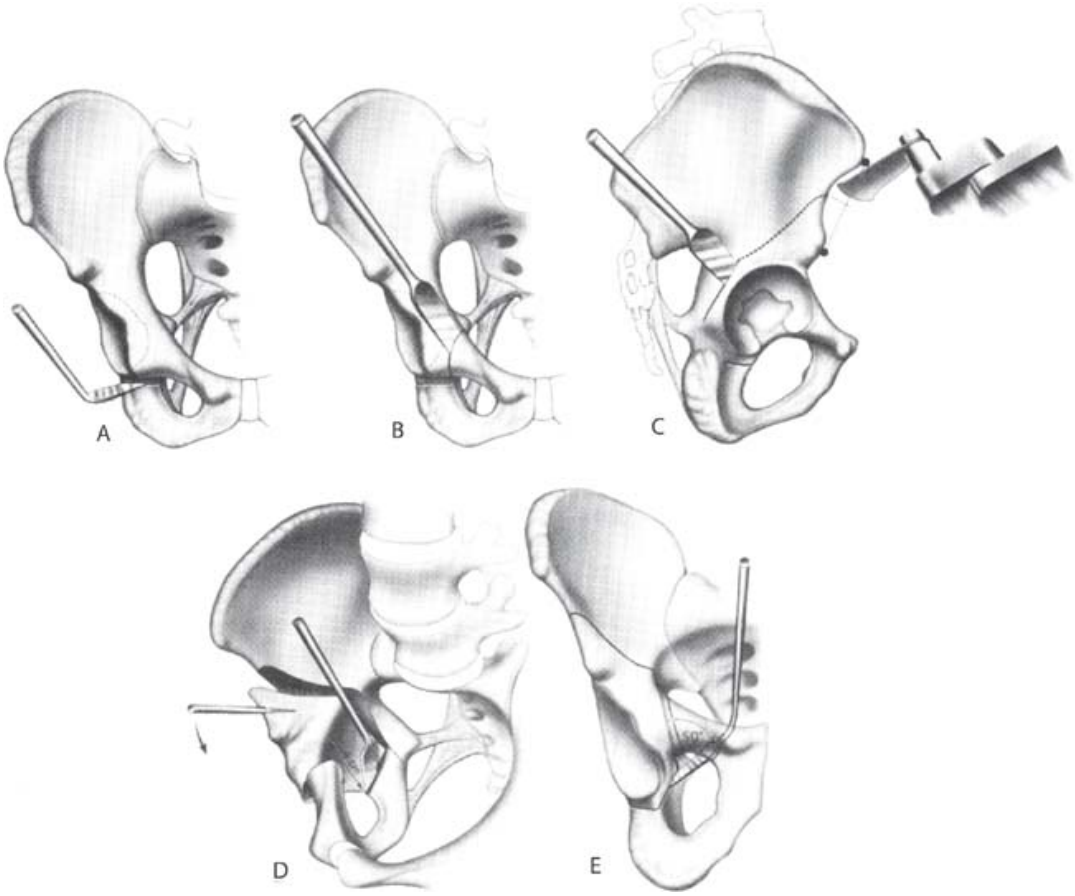

Figure 10.4-4. 4. The Bernese periacetabular osteotomy. (Reproduced with permission from Ganz R, Klaue K, Vinh TS, et al: A new periacetabular osteotomy for the treatment of hip dysplasias: technique and preliminary results. *Clin Orthop* 1988; 232:26–36.)

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Patient Population Characteristics

Age range	20–50 yr
Male:Female	3–4 × higher incidence in females for congenital hip dysplasia; equal incidence for other causes
Etiology	Congenital hip dysplasia; neuromuscular disorders (cerebral palsy, meningomyelocele); pediatric trauma to acetabular

	growth plate
Associated conditions	Depends on Dx

Anesthetic Considerations

See Anesthetic Considerations for Procedures about the Pelvis and Hip (p. 989).

Suggested Readings

1. Chiari K: Iliac osteotomy in young adults. In *The Hip: Proceedings of the 7th Open Meeting of the Hip Society.* CV Mosby, St. Louis: 1979, 260–77.

2. Ganz R, Klaue, K, Vihn TS, et al: A new periacetabular osteotomy for the treatment of hip dysplasias. *Clin Orthop* 1988; 232:26–36.

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4. Salter RB, Thompson GH: The role of innominate osteotomy in young adults. In *The Hip: Proceedings of the 7th Open Meeting of the Hip Society.* CV Mosby, St. Louis: 1979, 278–312.

5. Sutherland DH, Greenfield R: Double innominate osteotomy. *J Bone Joint Surg* 1977; 59(8):1082–91.

Arthrodesis of the Sacroiliac Joint

Surgical Considerations

Description: In this procedure, a painful and/or unstable sacroiliac (SI) joint is fused, usually by excising the joint through an **anterior** or **posterior approach** and employing an iliac crest bone graft. Supplemental screw fixation of the joint is used. The incision follows the iliac crest from the anterior superior iliac spine past the convexity of the iliac tubercle; the aponeurosis of the external abdominal musculature is elevated from the iliac crest. The internal iliac fossa is exposed subperiosteally, posterior to the SI joint; then the joint cartilage is excised and packed with cancellous bone strips. The SI joint is fixed with plates and screws. Alternatively, a posterior approach to the SI Joint may be used. A straight vertical incision is made just lateral to the posterior superior iliac spine. The origin of the gluteus maximus is elevated from its origin off the posterior ilium and sacrum and reattached laterally. The SI joint is identified, débrided of cartilage, and packed with strips of cancellous bone. It is then fixed with screws.

Variant procedure or approaches: Anterior or posterior approach

Usual preop diagnosis: Arthritis or arthrosis of the SI joint; pelvic instability

Summary of Procedures

Position	Supine (anterior) or prone (posterior)
Incision	Lateral portion of ilioinguinal (anterior); posterior approach to SI joint (posterior)
Special instrumentation	Radiolucent table; pelvic instruments and implants; I.I.; Cell Saver
Unique considerations	Intraop radiographs or use of I.I.
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)

Surgical time	2–3 h
EBL	250–500 mL
Postop care	Usually on protected, weight-bearing walker or crutches × 6–8 wk; anticoagulation for DVT prophylaxis
Mortality	Extremely low
Morbidity	Ileus: Virtually always Osteomyelitis: < 1% Wound infection: < 1% Genitourinary problems; urinary retention requiring catheterization: Common Delayed union, nonunion, malunion, leg-length discrepancy: Not uncommon Neurological deficit; injury to lumbosacral plexus: Rare, unless present preop; L5 nerve root susceptible in anterior approaches Hypotension 2° to retroperitoneal hematoma: Rare Injury to bowel: Rare Vascular complications; injury to iliac arteries: Rare Thromboembolism
Pain score	7

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Patient Population Characteristics

Age range	20–50 yr
Male:Female	Increased incidence in males (trauma)
Incidence	Rare
Etiology	Trauma—postpelvic fracture dislocation; painful septic arthritis

Anesthetic Considerations

See Anesthetic Considerations for Procedures about the Pelvis and Hip (p. 989).

Suggested Readings

1. Christian CA, Donley BG: Arthrodesis of the ankle, knee and hip. In *Campbell's Operative Orthopaedics,* Vol 1, 9th edition. Crenshaw AH, ed. Mosby-Year Book, St. Louis: 1998, 145–88.

2. Guyton JL: Fractures of hip, acetabulum, and pelvis. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. Mosby-Year Book, St. Louis: 1998, 2042–80.

3. Jones A, Reinert C, Bucholtz R: Complications of fractures of the pelvic ring and acetabulum. In *Complications in Orthopaedic Surgery,* 3rd edition. Epps CH Jr, ed. JB Lippincott, Philadelphia: 1994, 749–62.

4. Kane WJ: Complications of pelvic fractures and their treatment. In *Complications in Orthopaedic Surgery.* Epps CH Jr, ed. JB Lippincott, Philadelphia: 1986, 795–814.

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7. Rice PL Jr, Rudolph M: Pelvic fractures. *Emerg Med Clin North Am* 2007; 25(3):795–802.

8. Russell TA: Arthrodesis of the lower extremity and hip. In *Campbell's Operative Orthopaedics,* Vol 2, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998.

Amputations About the HIP and Pelvis: Disarticulation of the HIP and Hindquarter Amputation

Surgical Considerations

Description: These surgical procedures accomplish an excision of the entire lower extremity. In a **hip disarticulation,** the amputation is performed through the hip joint. An anterior, racquet-shaped incision is made and all muscles *(Print pagebreak 988)* crossing the hip joint are incised or detached. The femoral artery, vein, and nerve; obturator vessels; sciatic nerve; and deep vessels are isolated and ligated. The gluteal flap is brought anteriorly and sewn to the anterior portion of the incision. In a **hindquarter amputation,** excision of the lower extremity, hip joint and a portion of the pelvis is performed. Anterior and posterior incisions are used and the iliac wing is divided posteriorly and the symphysis pubis is disarticulated anteriorly. Either the common iliac or external iliac vessels are ligated, as are all nerves to the lower extremity. Usually the gluteal flap is drawn anteriorly for closure. These procedures are performed very rarely—for severe trauma, tumor, or infection—and are often life-saving surgeries. They often are performed in conjunction with a general surgeon, and standard bowel prep is done. The operations are long and tedious, with extensive blood loss, in patients who are usually systemically ill.

Usual preop diagnosis: Malignant tumor of femur, hip or pelvis; traumatic amputation to femur, hip, or pelvis; uncontrollable infection to leg, hip, or pelvis (e.g., clostridia)

Summary of Procedures

	Hip Disarticulation	Hindquarter Amputation
Position	Supine	Lateral decubitus; stabilized by bean bag and/or kidney rests.
Incision	Anterior racquet type (rare)	Anterior and posterior
Unique considerations	Urinary catheter should be placed.	Urinary catheter; NG tube; scrotum strapped to opposite thigh; anus stitched closed/sealed.
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)	
Surgical time	3–4 h	4–5 h
EBL	1,000–2,000 mL (intraop blood salvage system recommended, except for tumors)	2,000–3,000 mL
Postop care	ICU	
Mortality	Rare in patients undergoing elective amputation for trauma or localized tumor; higher for patients with debilitated trauma, chronic infection or extensive invasive malignant tumor; highest in clostridial infections: 50%+	
Morbidity	Anemia: Common Electrolyte abnormalities: Common Hematoma: Common	

	Neurological injury to lumbosacral plexus or peripheral nerves: Common Paralytic ileus: Common Psychosocial problems: Common UTI: Common Flap necrosis: Not uncommon Incomplete excision with recurrence of tumor or infection: Not uncommon Injury to peritoneal or retroperitoneal contents, in cluding bowel and bladder: Not uncommon Vascular injury—iliac, other vessels: Not uncommon	
Pain Score	10	10

Patient Population Characteristics

Age range	Any age
Male:Female	Similar, except higher incidence in males for traumatic etiologies
Incidence	Uncommon
Etiology	Malignant tumor; trauma; infection—clostridial myonecrosis, chronic osteomyelitis, etc.

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Anesthetic Considerations for Procedures about the Pelvis and HIP

(Procedures covered: ORIF, pelvis, acetabulum; closed reduction, external fixation, pelvis; osteotomy and bone graft of pelvis; arthrodesis of SI joint; amputations about hip and pelvis: disarticulation of hip and hindquarter amputation)

Preoperative

Patients presenting for pelvic surgery generally fall into two categories: 1) Major trauma—pelvic fracture requires substantial force and seldom occurs alone. These patients require aggressive fluid resuscitation with large-bore iv's and invasive monitors (arterial line and CVP). If the patient can be made hemodynamically stable with volume resuscitation, a thorough evaluation for coexisting neurological, thoracic, or abdominal trauma should be undertaken before anesthesia. 2) Tumor resection and amputation of thigh, hip, and pelvis. Because of large intraop blood loss and 3rd-spacing of fluids, invasive hemodynamic monitoring is necessary. Although epidural anesthesia is seldom adequate for surgery, postop epidural analgesia is an effective means of controlling the tremendous pain caused by this type of surgery. Other patient populations covered in this section include otherwise healthy patients with congenital or acquired hip dysplasia presenting for augmentation procedures.

Respiratory	Trauma patients are at risk for hemothorax, pneumothorax, pulmonary contusion, fat embolism (preop and postop), and aspiration. A chest tube will be needed before surgery if either a hemothorax or pneumothorax is present. Pulmonary fat embolus occurs in 10–15% of patients with long-bone fractures, and can occur after isolated pelvic fractures. Sx include hypoxemia, tachycardia, tachypnea, respiratory alkalosis, mental status changes, conjunctival petechiae, fat bodies in the urine, and diffuse pulmonary infiltrates. Sx of pulmonary aspiration are similar to those of fat embolism. Preop therapy for either should include supplemental O_2 to correct hypoxemia (may necessitate mechanical ventilation) and meticulous fluid management to

	prevent worsening of pulmonary capillary leak. **Tests:** CXR, or others as indicated from H&P.
Cardiovascular	Blunt chest trauma can produce both cardiac contusion and aortic tear. Preop ECG and CPK isoenzymes will help evaluate the presence of myocardial injury. A wide mediastinal silhouette suggests aortic tear, which requires evaluation with TEE or angiography. **Tests:** Consider ECG; CPK isoenzymes; others as indicated from H&P.
Neurological	The possibility of coexistent neurologic trauma necessitates a thorough preop mental status review and peripheral sensory exam. A CT scan of the head is indicated for any patient with loss of consciousness prior to anesthesia.
Musculoskeletal	For trauma patients, C-spine films will evaluate the stability of the C-spine before neck manipulation during ET intubation. Thoracic and lumbar x-rays also should be evaluated for the presence of traumatic spinal deformity or instability that would require special stabilization in the anesthetized patient. **Tests:** C-spine x-rays or others as indicated from H&P.
Hematologic	Restore Hct to 25% prior to inducing anesthesia. Have available 1 blood volume (70 mL/kg) or l total erythrocyte mass (20 mL/kg) for intraop transfusion. Transfusions of more than 1 blood volume will require monitoring and possible replacement of Plts and coag factors. The incidence of DVT is very high in these patients, and prophylaxis with SCDs or low-dose sc heparin is indicated whenever feasible.
Renal	Renal injury commonly results from trauma to the collecting system, myoglobinuria from rhabdomyolysis and ischemic, acute, tubular necrosis from hypovolemia or aortic dissection. Foley catheters should be placed only after urologic consultation for possible urethral tear. Suprapubic catheters are often necessary. Monitoring of UO is mandatory to detect intraop compromise of the collecting system, and to monitor adequacy of renal perfusion. **Tests:** Consider UA; BUN; Cr; others as indicated from H&P.
Laboratory	Hct; electrolytes; other tests as indicated from H&P.
Premedication	In hemodynamically stable patients, pain can be treated with morphine (1–2 mg iv q 10 min titrated to pain relief) prior to anesthesia.

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Intraoperative

Anesthetic technique: GETA is indicated due to the duration and extent of the surgery, as well as the varied positions that are necessary to accomplish pelvic fixation. Regional anesthesia is generally inadequate for major pelvic surgery; however, in elective surgeries, serious consideration should be given to postop epidural analgesia.

Induction	A rapid-sequence induction (see p. B-4) is necessary for trauma patients to minimize aspiration risk. Elective cases can undergo a standard induction (see p. B-2).
Maintenance	Standard maintenance (see p. B-2).
Emergence	Extubate trauma patients when fully awake and protective airway reflexes have returned. Do not extubate patients with evolving pulmonary injuries (fat embolism, aspiration, or contusion). Monitoring in an ICU usually is indicated for trauma and cancer patients. Prolonged stays can be anticipated for patients with severe coexistent trauma.

Blood and fluid requirements	Large blood loss IV: 14–16 ga × 2 NS/LR @ 8–12 mL/kg/h 2–4 U PRBC in OR Warm fluids. Humidify gases.	Expect large blood losses (from 0.5–2 or more blood volumes) with all but augmentation procedures. Cell-scavenging techniques are useful to reduce the requirement for blood. Care should be taken to ensure that cells have been adequately washed to minimize ↓ BP on reinfusion.
Control of blood loss	Deliberate hypotension Hemodilution	Patients with severe cardiovascular disease or carotid artery stenosis are not candidates for ↓ BP. Full replacement of any volume deficit is mandatory before inducing ↓ BP. Commonly used agents are isoflurane (1–3%) or esmolol (50–200 mcg/kg/min) ± SNP (0.25–3 mcg/kg/min). These agents are titrated to produce a 30% ↓ in preop MAP (but not < 60 mmHg).
Monitoring	Standard monitors (see p. B-1). Arterial line CVP line ± PA catheter ± TEE UO	Patients for shelf procedures may require only standard monitoring. Patients with myocardial dysfunction should have fluid and inotropic/pressor therapy, guided by continuous central venous saturation monitoring, a PA catheter and/or TEE.
Positioning	and pad pressure points. eyes.	Meticulous padding of the chest, pelvis, and extremities is imperative to prevent nerve injury and ischemia of the extremities. ↓ BP → risk of neurovascular injury.
Complications	Hypothermia Damage to urinary collecting system Major blood loss Coagulopathy	Warming of hypothermic patient may unmask severe volume depletion that will increase fluid requirement to well above apparent losses.

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Postoperative

Complications	Nerve root damage Peripheral nerve damage	Preop or intraop damage to L4-S5 nerve roots and cauda equina, resulting in hemiplegia and bladder and bowel dysfunction. Neuropathy of the femoral, genitofemoral, and lateral femoral cutaneous nerves can result from pressure on the ilioinguinal ligament during surgery.
	IV morphine	Morphine 1–2 mg iv q 10 min prn Epidural hydromorphone 50 mcg/mL

Pain management	Spinal opiates	infused at 100–250 mcg/hr, ± bupivacaine 0.125–0.25% at 4–8 mL/h, provides excellent analgesia.
Tests	Hct CXR Coag profile, as indicated.	

Suggested Readings

1. Fung DL: Anesthesia and pain management. In *Chapman's Orthopaedic Surgery,* 3rd edition, Vol I. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 133–56.

2. Masursky D, Dexter F, McCartney CJ, et al: Predicting orthopedic surgeons' preferences for peripheral nerve blocks for their patients. *Anesth Analg* 2008; 106(2):561–7.

3. McCollough NC III: Complications of amputation surgery. In *Complications in Orthopaedic Surgery,* 3rd edition. Epps CH Jr, ed. JB Lippincott, Philadelphia: 1994.

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5. Ranawat AS, Ranawat CS: Pain management and accelerated rehabilitation for total hip and total knee arthroplasty. *J Arthroplasty* 2007; 22(7 Suppl 3):12–5.

6. Rosencher N, Bonnet MP, Sessler DI: Selected new antithrombotic agents and neuraxial anaesthesia for major orthopaedic surgery: management strategies. *Anaesthesia* 2007; 62(11):1154–60.

7. Tooms RE: Amputations of lower extremity. In *Campbell's Operative Orthopaedics,* Vol 1, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998, 532–47.

Arthroplasty of the Hip

Surgical Considerations

Description: Total hip arthroplasty is one of the most successful procedures in orthopedic surgery. In this procedure, the hip joint (Fig. 10.4-5) is approached through one of several standard incisions. The femoral head is dislocated from the acetabulum, and the arthritic femoral head and a portion of the neck are excised. The acetabulum is reamed to accept a cemented or cementless cup made of metal and plastic. The femoral stem and head are usually modular, allowing for numerous shapes, sizes, lengths, etc. The metallic femoral component may be cemented or cementless. A hybrid total hip combines a cemented femoral stem and a cementless acetabular cup. After relocation *(Print pagebreak 992)* of the new prosthetic hip joint and closure of the tissues, the patient may be given an abduction pillow to minimize the risk of dislocation. Mobilization takes place over the ensuing days.

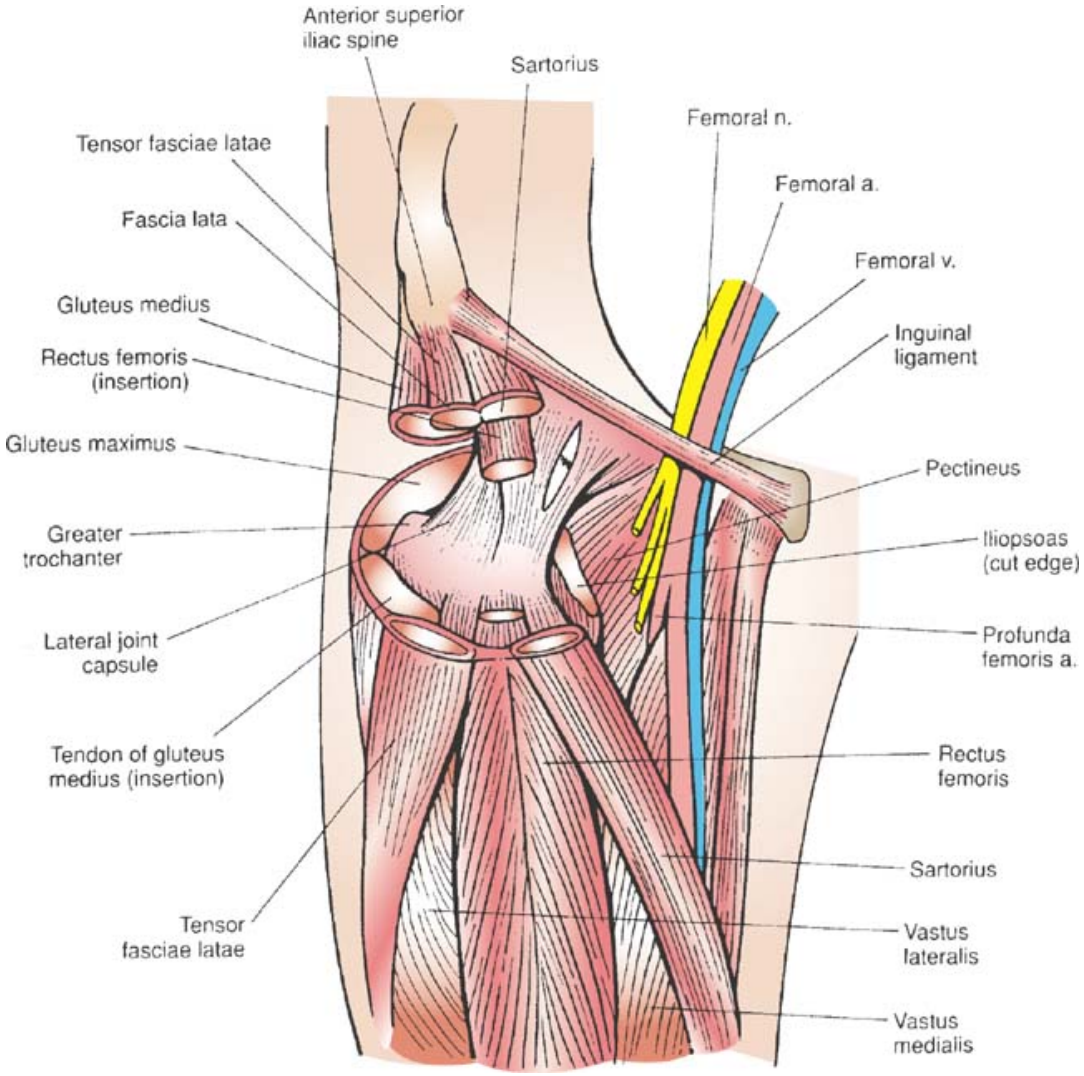

Figure 10.4-5. 5. Surgical exposure of the hip joint. The hip joint may be exposed through a number of approaches. The relevant anatomical landmarks are shown here. (Reproduced with permission from Hoppenfeld S, deBoer P: *Surgical Exposures in Orthopaedics.* JB Lippincott, Philadelphia: 1984.)

Variant procedure or approaches: Unipolar (only the femoral side is replaced); **bipolar** (both the femoral side and the acetabular side are replaced; the acetabular cup is not fixed to the pelvis). **Revision procedures** are more arduous and time-consuming, as the "failed" or loose component(s) must be removed and the bone prepared to accept new cemented or cementless components. These procedures require more specialized equipment for extracting prostheses and cement, and rebuilding the femoral or acetabular bone stock (allografts, autografts, etc.). Often, special components are needed for implantation of a new prosthesis. In the **Girdlestone procedure (resection arthroplasty),** the components are removed, but not replaced. This procedure is usually performed for infection.

Usual preop diagnosis: Fracture of femoral neck; arthritis of hip; arthrosis of hip; loose (or malpositioned) hip prosthesis; chronic dislocation of hip arthroplasty; infected hip arthroplasty

(Print pagebreak 993)

Summary of Procedures

	Unipolar, Bipolar, Total Hip Replacement	Revision, Total Hip Replacement	Girdlestone Resection Arthroplasty
Position	Supine (for anterior or anterolateral approaches); lateral decubitus position (for lateral or posterior approaches)		

Incision	Anterolateral, lateral or posterolateral over hip joint		
Special instrumentation	Appropriate prostheses and instrumentation	Special instruments for excising cement	
Unique considerations	In lateral decubitus position, patient is usually stabilized by bean bag and/or kidney rests. SCDs used.	A trochanteric osteotomy may be performed.	
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)		after intraop cultures
Surgical time	2–3 h	3–6 h or more	3 h or more
EBL	250–750 mL (intraop blood retrieval system may be useful).	≥ 1,000 mL; intraop blood retrieval recommended.	
Postop care	Patient's legs immobilized between abduction wedge; or operated leg suspended in a splint or placed in traction.		
Mortality	1–2% (increasing with age)		
Morbidity	DVT: • Without prophylaxis: ≥ 50% • With chemoprophylaxis and mechanical prophylaxis: 2–3%		
	Heterotopic ossification: 3–50% (average, 13%; significant, 4–5%)	> 3–50%	
	Intraop cementless fracture: 5–20%		
	UTI: 7–14%		
	Late aseptic loosening requiring revision: 5–10% (after 10 yr)	> 5–10%	
	Wound infection: 1% • Primary psoriatic and diabetic patients: 5–10% • Primary OA: 1%	3–10%	
	Hematoma (major): < 5%		5–10%
	Femoral/sciatic nerve injury: 0.7–3.5%		
	PE: 1.8–3.4% (if no prophylaxis)		
	Intraop cemented fracture: 1–3%	2–3%	1–3%
	Postopsubluxation/dislocation: 0.5–3%		–
	Vascular injury to iliac vessels: < 0.5%	> 0.5%	
	Urinary retention requiring catheterization: Common		
	GI bleed, MI, cholecystitis: Rare	Neurological injury: 3–10%	–
Pain score	7	8	8

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Patient Population Characteristics

Age range	Hip fracture and cases of arthrosis of the hip joint: generally > 60 yr Arthritis of the hip (e.g., rheumatoid arthritis or juvenile rheumatoid arthritis, traumatic arthritis): all ages
Male:Female	Dependent on disease etiology
Incidence	Common: approximately 250,000/yr in United States
Etiology	Osteoarthritis; seropositive or seronegative arthritis; avascular necrosis; traumatic arthritis; congenital dislocation of the hip
Associated conditions	Dependent on primary conditions (e.g., rheumatoid arthritis patients may have numerous deformities, cardiorespiratory disease, etc.)

Anesthetic Considerations

See Anesthetic Considerations for Hip Procedures (p. 997).

Suggested Readings

1. Berry DJ: Primary total hip arthroplasty. In *Chapman's Orthopaedic Surgery,* 3rd edition, Vol III. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 2769–94.

2. Bierbaum BE, Pomeroy DL, Berklacich FM: Late complications of total hip replacement. In *The Hip and its Disorders.* Steinberg ME, ed. WB Saunders, Philadelphia: 1991, 1061–96.

3. Harkey JW: Arthroplasty of hip. In *Campbell's Operative Orthopaedics,* Vol I, 9th edition. Crenshaw AH, ed. Mosby-Year Book, St. Louis: 1998, 473–520.

4. Malik A, Dorr LD: The science of minimally invasive total hip arthroplasty. *Clin Orthop Relat Res* 2007; 463:74–84.

5. Ranawat CS, Figgie MP: Early complications of total hip replacement. In *The Hip and its Disorders.* Steinberg ME, ed. WB Saunders, Philadelphia: 1991, 1042–60.

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Arthrodesis of the HIP

Surgical Considerations

Description: In adults, this procedure is accomplished by fusing the femur to the acetabulum. Some form of internal fixation is usually employed; a spica cast is sometimes placed immediately postop or a few days later. The patient is usually not a good candidate for total hip arthroplasty (e.g., a young, healthy male with unilateral traumatic arthritis). The hip usually is fused in 30° of flexion, 10–30° of external rotation, and neutral-to-slight adduction. The surgical procedure may be performed through anterior, lateral, or posterior incisions with the lateral being most common. A **trochanteric osteotomy** facilitates exposure. After excising the cartilage surfaces, internal fixation, using screws ± a plate, is performed (Fig. 10.4-6).

Usual preop diagnosis: Arthritis or arthrosis of the hip; previous septic arthritis of the hip; recurrent subluxation or dislocation of the hip

Summary of Procedures

Position	Usually supine; occasionally lateral decubitus
Incision	Anterior or lateral thigh
Special instrumentation	Plates and screws or other internal fixation; reamers from surface replacement arthroplasty set also may be useful; intraop x-ray; fracture table
Unique considerations	Intraop radiographs or I.I. used with patient on fracture table
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)
Surgical time	3–4 h
EBL	500–1,000 mL; Cell Saver recommended.
Postop care	Spica cast
Mortality	Extremely low
Morbidity	Limb shortening: Some shortening is always present Delayed union, nonunion, malunion: 10–15% Femoral shaft fracture: 5–10% Wound infection: < 1% Genitourinary problems: urinary retention requiring catheterization: Common Ileus: Common Late degenerative arthritis of other lower extremity joints or back: Common, many yr later Injury to iliac or femoral vessels: Rare Neurological deficit; injury to lateral cutaneous nerve, sciatic, or femoral nerves: Not uncommon Osteomyelitis: Rare Vascular complications: Rare Superior mesenteric artery syndrome causing duodenal obstruction: Extremely rare Thromboembolism: See Arthroplasty of the Hip, p. 993.
Pain score	9

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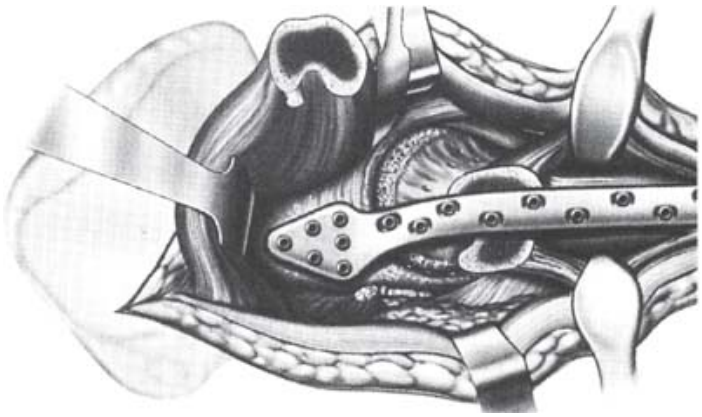

Figure 10.4-6. 6. Application of cobra plate after it has molded to the shape of the acetabulum and femur, and initial fixation with one proximal + distal outrigger compression screws. (Reproduced with permission from Sledge CB, ed: *The Hip.* Lippincott-Raven: 1998.)

Patient Population Characteristics

Age range	18–50 yr
Male:Female	Usually males > females
Incidence	Rare
Etiology	Trauma, general; neuromuscular disorders (cerebral palsy, meningomyelocele); trauma to acetabular growth plate; congenital hip dysplasia
Associated conditions	Depends on etiology.

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Anesthetic Considerations

See Anesthetic Considerations for Hip Procedures (p. 997).

Suggested Readings

1. Carnesale PG, Stewart MJ: Complications of arthrodesis surgery. In *Complications in Orthopaedic Surgery.* Epps CH Jr, ed. JB Lippincott, Philadelphia: 1986, 1289–1306.

2. Gill PS, Paprosky WG: Failed hip arthroplasty: revision and arthrodesis. In *Chapman's Orthopaedic Surgery,* 3rd edition, Vol III. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 2795–2858.

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4. Russell TA: Arthrodesis of the lower extremity and hip. In *Campbell's Operative Orthopaedics,* Vol 2. Crenshaw AH, ed. CV Mosby, St. Louis: 1987, 1091–1130.

Synovectomy of the Hip

Surgical Considerations

Description: An **arthrotomy** of the hip joint is performed through one of several standard approaches (anterior, anterolateral, lateral, posterior). A **capsulotomy** is performed, and is closed with reabsorbable sutures later in the case. Generally, the hip is not dislocated, but the cartilage surfaces are inspected and documented. The synovium, as well as any loose bodies, cartilage flaps, and osteophytes, are excised. Although weight-bearing is usually protected, ROM and strengthening exercises are begun early.

Usual preop diagnosis: Chronic synovitis of hip; loose bodies in hip; juvenile and adult rheumatoid arthritis; pigmented villonodular synovitis; synovial chondromatosis

Summary of Procedures

Position	Supine for anterior or anterolateral surgical approaches; lateral decubitus for posterior approaches
Incision	Overlying hip joint, depending on specific surgical approach
Unique considerations	Patient may have systemic disease (e.g., rheumatoid arthritis); careful positioning of limbs is necessary to avoid fracture or skin slough.

Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)
Surgical time	2 h
EBL	< 500 mL
Mortality	Rare
Morbidity	Thromboembolism: 10–50% Neurovascular injury—femoral or sciatic nerve, or iliac vessels: < 3% Wound infection or dehiscence: < 3% Septic arthritis and osteomyelitis: < 1% (unless synovectomy is performed for infection). Avascular necrosis of femoral head: Rare (if hip is not dislocated). Hematoma: Rare (if drainage tubes used). Inability to void, requiring urinary catheterization: Common
Pain score	7–8

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Patient Population Characteristics

Age range	< 60 yr
Male:Female	Dependent on disease etiology (e.g., preponderance of females in rheumatoid arthritis)
Incidence	Rare
Etiology	Septic arthritis (very common); rheumatoid arthritis, juvenile/adult (rare); pigmented villonodular synovitis (rare); trauma (rare)
Associated conditions	See Etiology, above.

Anesthetic Considerations for HIP Procedures

(Procedures covered: hip arthroplasty, arthrodesis, synovectomy)

Preoperative

Osteoarthritis is the most common indication for hip arthroplasty. These patients are usually elderly and their anesthetic management is tailored to any concurrent disease. Rheumatoid and other inflammatory arthritides form another group of candidates for these procedures and the special anesthetic considerations for these patients are outlined below. Avascular necrosis of the hip is seen in patients with sickle-cell disease and in heart transplant patients.

Respiratory	Patients with rheumatoid arthritis frequently have associated pulmonary complications. SOB on performing activities of daily living or exercise (e.g., climbing a flight of stairs) warrants further evaluation with PFTs. Pulmonary effusions are common. Pulmonary fibrosis (rare) often manifests as cough and dyspnea. Rheumatoid arthritis involvement of the cricoarytenoid joints may produce glottic narrowing (requiring small ETT) and manifest as hoarseness. Arthritic involvement of the TMJ limits mouth opening and may necessitate special techniques (e.g., fiber optic or light wand) for ET intubation. **Tests:** As indicated from H&P. The severity of the arthritis often limits exercise; thus, a dobutamine stress ECHO and/or dipyridamole/thallium imaging

Cardiovascular	may be necessary for adequate cardiac evaluation in patients with poor exercise tolerance. HTN and cardiovascular disease are common in elderly patients (dysrhythmias/TIAs → fall → hip fracture). Rheumatoid arthritis is associated with pericardial effusion, cardiac valve fibrosis, cardiac conduction abnormalities and aortic regurgitation (AR). An ECG is indicated in all rheumatoid arthritis patients, and ECHO is indicated for patients with physical Sx suggestive of tamponade or cardiovascular disease. **Tests:** As indicated from H&P.
Neurological	In patients with rheumatoid arthritis, a thorough neurological exam preop often yields evidence of cervical nerve-root compression. Patients with arthritis involving the cervical spine should have lateral neck films preop to determine the stability of the atlanto-occipital joint. After the stability of the spine has been established, full ROM of the neck should be evaluated for evidence of further nerve-root compression or cerebral ischemia (suggesting vertebral artery compression). Evidence of cerebral ischemia mandates a neurovascular evaluation to plan intraop BP management. **Tests:** As indicated from H&P.
Musculoskeletal	Pain and ↓ joint mobility make positioning and regional anesthesia difficult in patients with arthritis.
Hematologic	Rheumatoid arthritis patients often have anemia. Also, anemia may be 2° NSAID gastritis. Patients with Hb > 12 g/dL are candidates for preop autologous blood donation. Hip fracture → potential large-volume blood loss at fracture site. DVT is common after hip surgery, and prophylaxis for its occurrence reduces mortality. Effective preventive measures include SCDs and sc heparin. NSAID-induced coagulopathy may preclude the use of regional anesthesia. **Tests:** As indicated from H&P.
Renal	Estimation of renal function may be useful to predict drug clearance and the need for invasive monitoring in this elderly population. **Tests:** As indicated from H&P.
Laboratory	Other tests as indicated from H&P.
Premedication	In the absence of limited pulmonary reserve or severe cardiac disease, a standard premedication (see p. B-2) is appropriate. Full-stomach precautions (p. B-5) may be necessary for patients in acute pain.

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Intraoperative

Anesthetic technique: GETA or regional anesthesia (may be difficult 2° pain on positioning).

General anesthesia:

Induction	The lateral position may mandate ET intubation for patients undergoing GA. A careful preop airway evaluation will determine the need for special airway techniques (e.g., fiber optic intubation or light wand). Aggravation of cricoarytenoid arthritis that is common in rheumatoid arthritis patients can be minimized if a small ETT (6–7 mm cuffed) is used. For otherwise healthy patients, standard induction (p. B-2) is appropriate.
	Standard maintenance (p. B-2). Neuromuscular blockade

Maintenance	facilitates the placement and testing of the prosthesis. In otherwise healthy patients, induced hypotension (e.g., ↓ 20%) →↓ blood loss.
Emergence	No special considerations

Regional anesthesia: Regional anesthesia offers the advantages of decreased periop DVT and pulmonary embolus, decreased intraop blood loss and a drier surgical field (which may improve conditions for cementing). However, induction of regional anesthesia, with its attendant positioning requirements, can be uncomfortable in patients with limited joint mobility. Rheumatoid arthritis patients, however, rarely have involvement of the lumbar spine, and regional anesthesia offers the advantages of decreased periop DVT, decreased intraop blood loss and no need for airway manipulation. Sedation or general anesthesia should be offered to supplement the regional technique. A typical dose for a subarachnoid block is 12.5–15 mg bupivacaine. 10–25 mcg of fentanyl and 100–200 mcg of morphine may be added for improved pain control up to 24 h postoperatively. Anesthesia to T10 is adequate. Full motor blockade is essential for placement of the prosthesis and assessment of the passive ROM. Lumbar epidural block (initial dose of 10–15 mL 2% lidocaine with epinephrine 1:200,000, administered over 10 min) has the advantage of slow onset, allowing time to treat the induced cardiovascular changes. Postop epidural opiates can provide excellent analgesia. Finally, a lumbar plexus block by the posterior approach (psoas compartment block) provides reliable postoperative analgesia, and hypotension and urinary retention are less common than with SAB or epidural analgesia. However, it is not sufficient for surgical anesthesia as the sole anesthetic. Continuous infusion is always initiated after the initial bolus of 15–20 mL of 0.125% bupivacaine or 0.2% ropivacaine.

Blood and fluid requirements	Major blood loss IV: 14–16 ga × 2 NS/LR @ 4–8 mL/kg/h	Cell scavenging helps reduce total transfusion requirement. Care should be taken to ensure that cells have been adequately washed to minimize ↓ BP on reinfusion.
Control of blood loss	Regional anesthesia Controlled hypotension	These techniques may be appropriate in selected patient populations.
Monitoring	Standard monitors (see p. B-1). ± CVP line ± Arterial line	Invasive monitoring is indicated in the presence of exercise-limiting cardiac or pulmonary disease.
Positioning	Axillary roll, bean bag and pad pressure points. eyes.	Meticulous padding of extremities and maintaining a neutral neck position are mandatory. A bean bag and axillary roll also are necessary to stabilize patient in the lateral position and to protect dependent arm from neurovascular compression injuries.
Complications	Methylmethacrylate: • ↓ BP 2° vasodilation • ↓ PaO_2 2° embolization • Cardiovascular collapse VAE Major blood loss DVT (femoral vein: 80%) Nerve damage Femur fracture	Microemboli of air, fat, bone fragments, and cement may occur during pressurized cementing which may lead to hypotension and hypoxia. Hypotension may be used to achieve a dry operating field, which improves cement penetration into the bone. However, significant hypovolemia must be avoided because this predisposes to a severe reaction to pressurized cementing. Systemic ↓ BP and pulmonary HTN may occur. Care should be taken to ensure that patient is adequately hydrated before and during the procedure, and pressors may be necessary to maintain BP (ephedrine 5–20 mg iv or epinephrine 10– 100 mcg iv and increasing the dose as necessary).

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Postoperative

Complications	Nerve damage DVT Continued blood loss	Sciatic nerve injury is evidenced by foot drop and an inability to flex the knee.
Pain management	Neuraxial regimens:	
	• SAB	Intrathecal morphine 0.2–0.3 mg provides analgesia for up to 24 h after administration. May be administered along with bupivacaine for surgical anesthesia.
	• Epidural analgesia	Epidural bupivacaine 0.0125% 6–8 mL/h and hydromorphone 50 mcg/mL infused at 100–250 mcg/h provides good analgesia. Prior to removal of the epidural catheter a 0.2 mg bolus of hydromorphone may be given. Epidural catheters are typically removed on the morning of postoperative day 2. Low-molecular-weight heparin may be started 2 h after catheter removal.
	Continuous lumbar plexus (psoas compartment) block	Infusion with 0.2% ropivacaine or 0.125% bupivacaine maintained at 6–12 mL/h.
	Systemic regimens	Oral pain management with acetaminophen should be initiated immediately postoperatively (if not contraindicated). Patient-controlled analgesia (PCA) with IV morphine or hydromorphone may be initiated as alternative to neuraxial blocks or to supplement a continuous lumbar plexus (psoas compartment) block.
Tests	Hct CXR, if CVP was placed. Monitor UO	

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Suggested Readings

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5. Rosencher N, Bonnet MP, Sessler DI: Selected new antithrombotic agents and neuraxial anaesthesia for major orthopaedic surgery: management strategies. *Anaesthesia* 2007; 62(11):1154–60.

Open Reduction and Internal Fixation (ORIF) of Proximal Femoral Fractures (Femoral Neck, Intertrochanteric, Subtrochanteric Fractures)

Surgical Considerations

Description: Fractures of the proximal femur are seen in two distinct populations: most commonly in elderly patients as the result of falls, and in younger patients following trauma. In elderly patients, the fracture occurs through osteoporotic bone in the femoral neck, intertrochanteric or subtrochanteric area (Fig. 10.4-9). Displaced femoral neck fractures are usually treated by **prosthetic replacement.** Nondisplaced or minimally displaced femoral neck fractures are usually treated by **closed reduction and percutaneous pinning** of the fracture. Intertrochanteric and subtrochanteric fractures, whether displaced or nondisplaced, are usually treated by **ORIF with a sliding hip screw and side plate, cephalomedullary nail, or blade plate** (Fig. 10.4-10). Prosthetic replacement is performed only rarely. Elderly patients frequently have numerous medical problems, which means that the fractures require prompt internal fixation/prosthetic replacement to facilitate early mobilization. In younger patients (16–40 yr), proximal femoral fractures are almost always treated by ORIF with screws, plates and screws, or intramedullary devices. These are normally much higher energy fractures, often associated with multiple traumas.

Variant procedure or approaches: Variants include: **percutaneous pinning** of nondisplaced femoral neck fracture; **ORIF of displaced femoral neck fracture** (also see Arthroplasty of the Hip, p. 991); **ORIF of intertrochanteric or subtrochanteric fracture.**

Usual preop diagnosis: Nondisplaced femoral neck fracture; displaced femoral neck fracture (those not requiring prosthetic replacement); intertrochanteric ± subtrochanteric fracture

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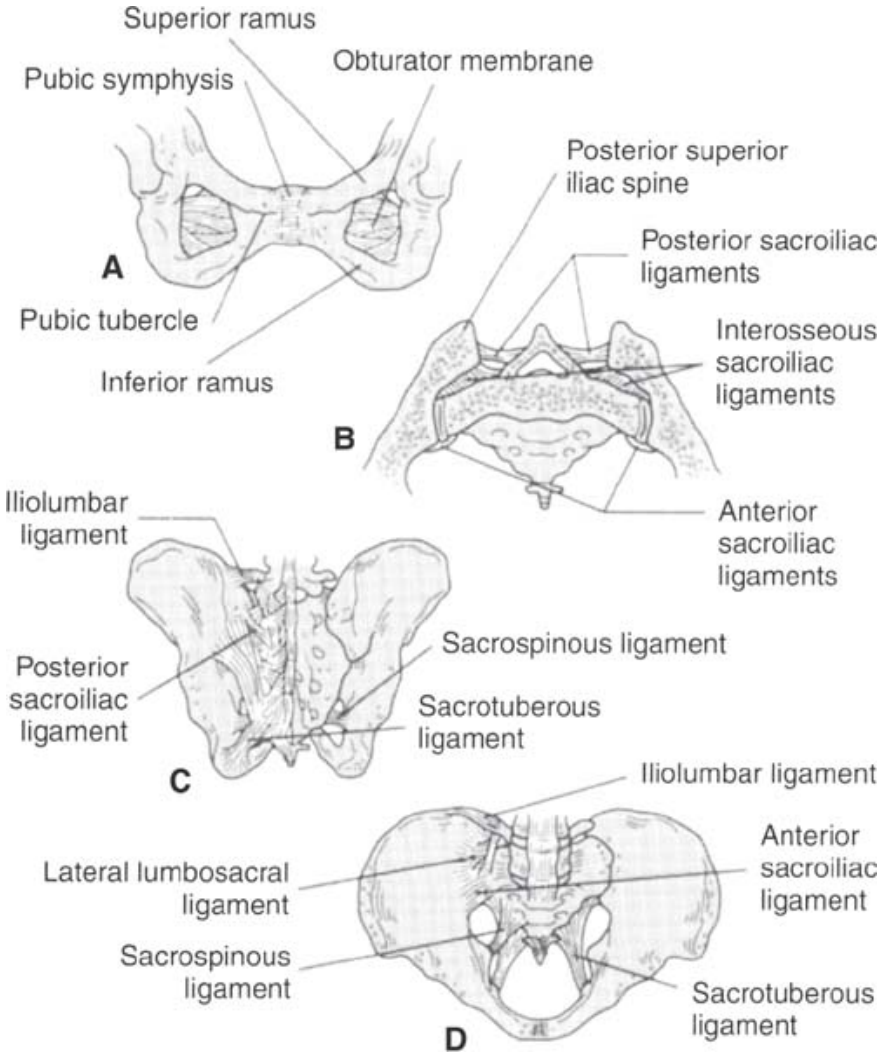

Figure 10.4-7. 7. Schematic views of the pelvis with the principal ligamentous supports. **A**: Symphysis pubis fibrocartilage. **B:** Posterior SI ligaments. **C:** Posterior view. **D:** Anterior view. (Reproduced with permission from Chapman MW: *Chapman's Orthopaedic Surgery,* Vol 1, 3rd edition. Lippincott Williams & Wilkins, 2001.)

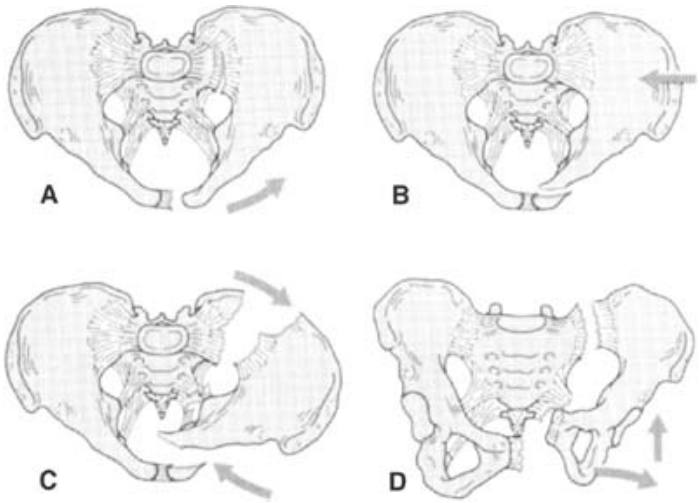

Figure 10.4-8. 8. Schematic view of the principal pelvis injury patterns, as determined by the vector of the provocative blow. **A:** Anteroposterior compression or external rotation injury. **B:** Stable lateral compression or internal rotation injury. **C:** Unstable lateral compression or internal rotation injury. **D:** Unstable vertical shear disruption. (Reproduced with permission from Chapman MW: *Chapman's Orthopaedic Surgery,* Vol 1, 3rd edition. Lippincott Williams & Wilkins: 2001.)

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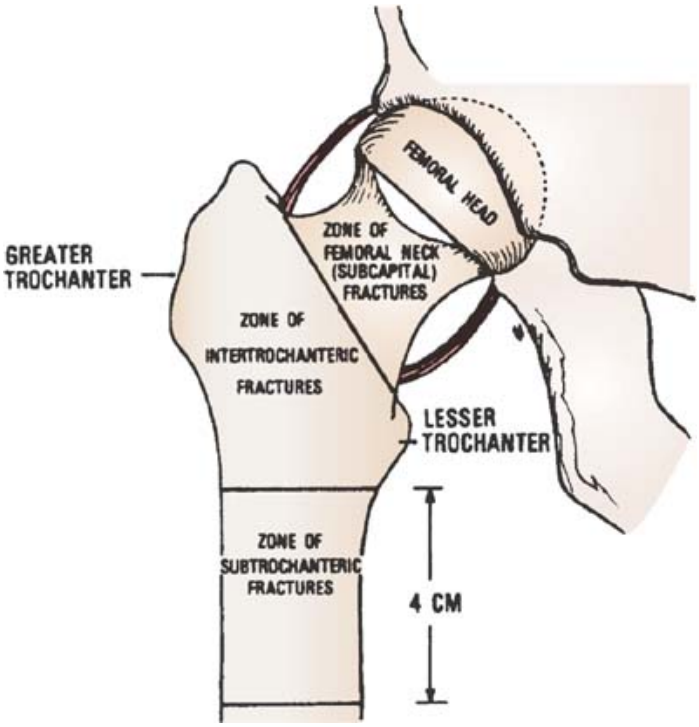

Figure 10.4-9. 9. Anatomical classification of fractures of the proximal femur. (Reproduced with permission from Hardy JD: *Hardy's Textbook of Surgery,* 2nd edition. JB Lippincott: 1988.)

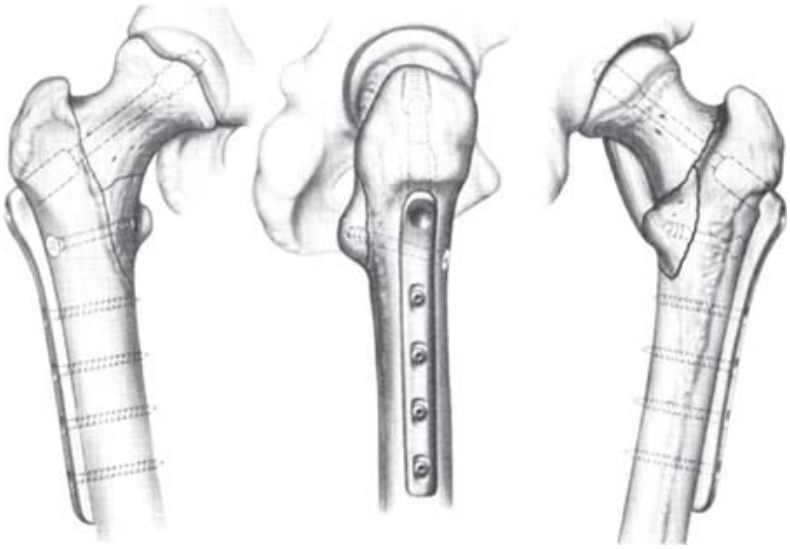

Figure 10.4-10. 10. Intertrochanteric hip fracture treated with dynamic hip screw. (Reproduced with permission from Sledge CB, ed: *The Hip.* Lippincott-Raven: 1998.)

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Summary of Procedures

	Nondisplaced Femoral Neck Fracture	Displaced Femoral Neck Fracture	Intertrochanteric ± Subtrochanteric Fracture
Position	Supine, on fracture table		
Incision	Proximal lateral thigh		
Special instrumentation	Usually multiple percutaneous pins	Multiple screws or other devices	Screw-plate device or intramedullary device
Unique considerations	Fracture table and I.I. used. Percutaneous pinning may be accomplished with local anesthesia only.		
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)		
Surgical time	1 h	1.5–2 h, including placing patient on fracture table and obtaining adequate reduction of fracture	1.5–3 h
EBL	< 100 mL	250–500 mL	500+ mL
Postop care	Generally PACU → room; if medically unstable, → ICU		
Mortality	10–30% in first 12 mo postop in elderly; in younger patients, depends on other involved trauma.		
Morbidity	Dysrhythmias: 50% MI: 50% Respiratory failure: 50% Urinary retention requiring catheterization: 50% UTI: 50% Thromboembolism: 40%+ Avascular necrosis and late		

	segmental collapse: 10–20% Infection, deep: 2–17% Infection, superficial: 2–17% Septic arthritis: 2–17%	≥15–35%	1%
	Nonunion: 5–15%	20–30%	2%
	Malunion: < 10%	> 10%	10–20%
	Loss of reduction: < %5	> 10%	10%
	Hematoma	–	–
	Intraop comminution of the fracture Neurological injury: Rare Vascular injury: Rare	–	–
Pain score	5–6	7	8

Patient Population Characteristics

Age range	Usually > 60 yr (patients with an intertrochanteric fracture average 65–70 yr); occasionally, younger patients, 16–35 yr (as part of multiple-trauma situation)
Male:Female	Elderly 1:4–5
Incidence	Extremely common—about 5–100/100,000; femoral neck fractures are about twice as common as intertrochanteric fractures.
Etiology	Accidents and falls (may be 2° TIA, stroke, MI, dysrhythmia); pathological fracture; multiple trauma (younger patients); stress fracture
Associated conditions	Numerous serious medical conditions often present in elderly; senile dementia; multiple trauma often

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Anesthetic Considerations

See Anesthetic Considerations for Lower-Extremity Procedures (p. 1059).

Suggested Readings

1. Chapman MW: Fractures of the hip and proximal femur. In *Chapman's Orthopaedic Surgery,* Vol I, 3rd edition. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 617–70.

2. Guyton JL: Fractures of the hip, acetabulum, and pelvis. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998, 2181–2280.

3. Kyle RF, Schmidt AH, Campbell SJ: Complications of the treatment of fractures and dislocations of the hip. In *Complications in Orthopaedic Surgery,* 3rd edition. Epps CH Jr, ed. JB Lippincott, Philadelphia: 1994, 443–86.

4. LaVelle DG: Delayed union and nonunion of fractures. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998, 2579–2630.

Open Reduction and Internal Fixation (ORIF) of Distal Femur Fractures

Surgical Considerations

Description: ORIF of the distal femur fracture involves a longitudinal incision along the femoral shaft, obtaining reduction by direct visualization of the fracture fragments, and applying plates and screws along the femur for rigid internal fixation. An iliac crest bone graft may be necessary. Some intramedullary devices are also available for fixation of these fractures.

Usual preop diagnosis: Fracture of the distal femur; nonunion/malunion of the distal femur; degenerative arthritis of knee, with deformity

Summary of Procedures

Position	Supine. Patient usually arrives at OR in balanced traction if fracture is acute.
Incision	Anterior knee, lateral or medial thigh along the femoral shaft
Special instrumentation	Special plates, screws, rods, reduction clamps; radiolucent table; intraop blood salvage
Unique considerations	Usually requires intraop radiographs; tourniquet.
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)
Surgical time	3 h (or more, depending on difficulty)
EBL	750 mL or more
Postop care	Multiple-trauma victim → ICU; others → PACU
Mortality	3–4%, depending on the extent of multiple trauma Nonunion: 4–33% Malunion: 4–31% Infection, osteomyelitis, septic arthritis; closed/open: Grade I: 1%5 Grade II: 5%20 Grade III: > 20%
Morbidity	Delayed union: 0–17% Vascular complications: 2–3% Neurological deficit to peripheral nerves, peroneal nerve: 3% Compartment syndrome: Rare Hypotension: Rare Leg-length discrepancy: Rare Respiratory distress and fat embolism: Rare
Pain score	8

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Patient Population Characteristics

Age range	Any age; predominance of males < 40 yr (trauma); degenerative arthritis of knee < 60 yr. Special rare case is elderly patient with a supracondylar fracture above a total knee replacement.
Male:Female	5:1
Incidence	Common in trauma center patients; rare in cases of degenerative arthritis of knee (osteotomy) or elderly patient with a supracondylar fracture above a total knee replacement.
Etiology	Motorcycle and motor vehicle accidents; falls; industrial injury; degenerative arthritis of knee
Associated conditions	Frequently associated with trauma to other organ systems.

Anesthetic Considerations

See Anesthetic Considerations for Lower-Extremity Procedures. (p. 1059).

Suggested Readings

1. LaVelle DG: Delayed union and nonunion of fractures. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998, 2579–2630.

2. Mize R, Johnson EE, Hohl M: Complications of fractures and dislocations of the knee. In *Complications in Orthopaedic* Surgery, 3rd edition. Epps CH Jr, ed. JB Lippincott, Philadelphia: 1994, 525–56.

3. Mize R: Supracondylar and articular fractures of the distal femur. In *Chapman's Orthopaedic Surgery,* 3rd edition, Vol I. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 709–23.

4. Whittle AP: Fractures of lower extremity. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998, 2042–2180.

5. Whittle AP: Malunited fractures. In *Campbell's Operative Orthopaedics,* 9th edition. Crenshaw AH, ed. Mosby, St. Louis: 1998, 2579–2630.

6. Wiss DA, Watson JT, Johnson EE: Fractures of the knee. In *Rockwood and Green's Fractures in Adults,* 4th edition. Rock-wood CA Jr, Green DP, Bucholz RW, Hickman JD, eds. Lippincott-Raven, Philadelphia: 1996, 1919–2000.

Open Reduction and Internal Fixation (ORIF) of the Femoral Shaft with Plate

Surgical Considerations

Description: ORIF of the femoral shaft involves obtaining a reduction by open means, usually through a longitudinal lateral incision along the length of the femur, and applying plates and screws along the femur to maintain the reduction. An iliac crest bone graft may be necessary.

Usual preop diagnosis: Fracture of femur

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Summary of Procedures

Position	Supine or lateral decubitus
Incision	Lateral thigh along length of femur ± iliac crest incision
Special instrumentation	Special plates, screws; reduction clamps; blood salvage device
Unique considerations	Fracture or radiolucent table; I.I. Patient usually arrives at OR in balanced traction.
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)
Surgical time	3 h or more, depending on difficulty
EBL	750 mL; Cell Saver recommended.
Postop care	Multiple-trauma victims: ICU Others: PACU

Mortality	Dependent on extent of multiple trauma
Morbidity	Knee stiffness: 20–30% Delayed union, nonunion, malunion: 5–21% Leg-length discrepancy: 0–11% Failure of fixation: 5–10% Infection, osteomyelitis: < 5% Hypotension: Not uncommon Respiratory distress and fat embolism: Not uncommon, often subclinical Compartment syndrome: Rare Neurological deficit to peripheral nerves: Rare Vascular complications: Rare
Pain score	9

Patient Population Characteristics

Age range	Any age, but predominance of males < 30 yr
Male:Female	5:1
Incidence	Unknown
Etiology	Motorcycle and motor vehicle accidents; falls; industrial injuries
Associated conditions	Frequently associated with trauma to other organ systems

Anesthetic Considerations

See Anesthetic Considerations for Lower-Extremity Procedures (p. 1059).

Suggested Readings

1. Azer R, Rankin EA: Complications of femoral shaft fractures. In *Complications in Orthopaedic Surgery,* 3rd edition. Epps CH Jr, ed. JB Lippincott, Philadelphia: 1986, 487–524.

2. Bucholz RW, Brumback RJ: Fractures of the shaft of the femur. In *Rockwood and Green's Fractures in Adults,* 4th edition. Rockwood CA Jr, Green DP, Bucholz RW, et al., eds. JB Lippincott, Philadelphia: 1996, 1827–1918.

3. LaVelle DG: Delayed union and nonunion of fractures. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998, 2579–2630.

4. Matta JM, Siebenrock KA, Gautier E, et al: Hip fusion through an anterior approach with the use of a ventral plate. *Clin Orthop* 1997; 337–129–39.

5. Whittle AP: Malunited fractures. In *Campbell's Operative Orthopaedics,* 9th edition. Crenshaw AH, ed. Mosby, St. Louis: 1998, 2579–2630.

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Intramedullary Nailing of Femoral Shaft

Surgical Considerations

Description: Intramedullary nailing of the femur is the standard procedure for fractures of the femoral shaft (Fig. 10.4.11). It is indicated for virtually any fracture, from the lesser trochanter to the distal femur, within 7 cm of the articular surface. The procedure also is used for the treatment of nonunions and malunions of the femoral shaft. Typically, the nail is placed in an anterograde fashion from proximal to distal. There are, however, indications in which the nail is inserted in a retrograde fashion from distal to proximal (e.g., bilateral femur fractures; ipsilateral femur and tibia fractures; distal femur fractures; and multiple-trauma, obese, and pregnant patients). Early fixation of femoral shaft fractures in severe polytrauma has several benefits. The advantages of early fixation of long bones include improved pain control, early mobilization, improved pulmonary function, and decreased morbidity and mortality.

Femoral nails are inserted after reaming the intramedullary canal, which allows a larger diameter implant and improves the mechanical properties of the bone implant interface. Reaming may produce systemic effects by embolic showering of medullary contents to the pulmonary vasculature, a phenomenon that has been documented by TEE. This situation may be exacerbated in the polytrauma patient with pulmonary injury, and may produce posttraumatic pulmonary failure. Patients with femur fractures may have associated injuries.

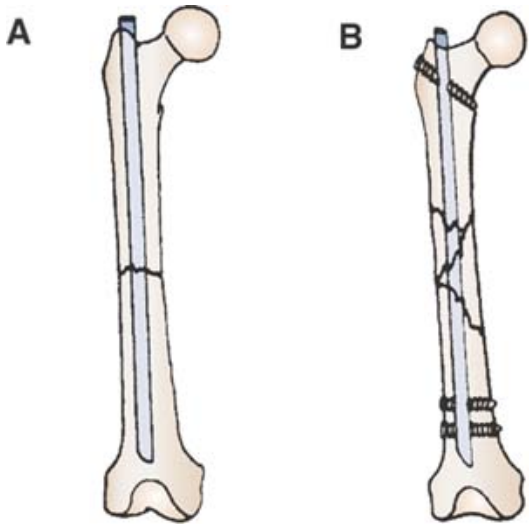

Figure 10.4-11. 11. A: Simple and **(B)** locked intramedullary fixation of femoral shaft. (Reproduced with permission from Hardy JD: *Hardy's Textbook of Surgery,* 2nd edition. JB Lippincott, Philadelphia: 1988.)

Patients may arrive from the ICU in skeletal traction or from the emergency department, especially in the case of an open fracture. Hemorrhage up to 1 L may be contained in the thigh following a femur fracture; therefore, patients may be hypovolemic at the start of the procedure. Since the procedure is essentially percutaneous, apparent blood loss may be underestimated because of the hemorrhaged blood contained in the thigh.

The patient is placed in the supine or lateral decubitus position on either a radiolucent table or a fracture table. Ante-grade insertion of the nail requires a lateral incision several cm in length proximal to the greater trochanter. The hip abductors are split, and portal into the femoral canal is created in the piriformis fossa. The femoral canal is reamed over a guide wire. The intramedullary nail is then inserted into the intramedullary canal with gentle taps, using a hammer.

Retrograde insertion of the nail is performed through an incision several cm long over the anterior aspect of the knee. The knee joint is entered and the portal to the intramedullary canal is made in the nonweight-bearing portion of the intercondylar notch. The nail is inserted in the same fashion as the anterior nail. Cross-locking screws are commonly used, and they are inserted through the rod.

Variant procedure or approaches: The application of femoral nailing has been expanded to treat nonunions, malunions, posttraumatic deformities of the femur, and leg-length differences. Specialized additional equipment, such as an intramedullary saw or an external fixator, may be required for these procedures.

Usual preop diagnosis: Femur fracture; nonunion/malunion of the femur; leg-length discrepancy

Summary of Procedures

Position	Supine or lateral decubitus

Incision	Proximal lateral thigh or anterior knee
Special instrumentation	Intramedullary nails; intramedullary saw for closed femoral shortening of femur; fracture or radiolucent table; I.I.
Unique considerations	Patient may have multiple traumas with other associated injuries. Procedure is heavily dependent on I.I.
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)
Surgical time	2–3 h; 3+ h for nonunion/malunion of femur or closed femoral shortening of femur
EBL	250–500 mL; ≥ 750 mL for nonunion/malunion of femur or closed femoral shortening of femur (Cell Saver recommended).
Postop care	If surgery performed acutely, patient is usually a multiple-trauma victim with numerous injuries and extensive blood loss; usually goes to ICU.
Mortality	Dependent on extent of trauma
Morbidity	Respiratory distress and fat embolism: 10% Malunion: 5–10% Infection, osteomyelitis: Open technique: 1–10% Closed technique: 0–1% Neurological deficit to peripheral nerves: 2% Vascular complications: 2% (up to 15% have occult vascular abnormalities) Delayed union: 1% Nonunion: 1% Hypotension: Common in multiple-trauma situations Knee stiffness: Common Leg-length discrepancies: Not uncommon Compartment syndrome: Rare Failure of fixation: Rare
Pain score	6

Patient Population Characteristics

Age range	Any age, but predominance of males < 30 yr
Male:Female	5:1
Incidence	Very common
Etiology	Motorcycle and motor vehicle accidents (60–80%); falls (5–10%); industrial injuries (5–10%); previous trauma (rare)
Associated conditions	Frequently associated with trauma to other organ systems.

Anesthetic Considerations

See Anesthetic Considerations for Lower-Extremity Procedures (p. 1059).

Suggested Readings

1. Azer R, Rankin EA: Complications of femoral shaft fractures. In *Complications in Orthopaedic Surgery,* 3rd edition. Epps CH Jr, ed. JB Lippincott, Philadelphia: 1986, 487–524.

2. Bone LB, Johnson KD, Weigelt J: Early versus delayed stabilization of femoral fractures: a prospective randomized study. *J Bone*

Joint Surg (Am) 1989; 71(3):336–40.

3. Bucholz RW, Brumback RJ: Fractures of the shaft of the femur. In *Rockwood and Green's Fractures in Adults,* 4th edition. Rockwood CA Jr, Green DP, Bucholz RW, et al., eds. Lippincott-Raven, Philadelphia: 1996, 1827–1918.

4. Chapman MW: Diaphyseal fractures of the femur. In *Chapman's Orthopaedic Surgery,* Vol I, 3rd edition. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 671–708.

5. Chapman MW: Fractures of the hip and proximal femur. In *Chapman's Orthopaedic Surgery,* Vol I, 3rd edition. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 617–70.

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6. LaVelle DG: Delayed union and nonunion of fractures. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998, 2579–2630.

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7. Mize RD: Supracondylar and articular fractures of the distal femur. In *Chapman's Orthopaedic Surgery,* 3rd edition, Vol I. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 709–23.

8. Pape HC, Regel G, Dwenger A: Influences of different methods of intramedullary femoral nailing on lung function in patients with multiple trauma. *J Trauma* 1993; 35(5):709–16.

9. Wenda K, Runkel M, Degeif J: Pathogenesis and clinical relevance of bone marrow embolism in medullary nailing—demonstrated by intraoperative echocardiography injury. *Injury* 1993; 24(Suppl 3):73–81.

10. Whittle AP: Malunited fractures. In *Campbell's Operative Orthopaedics,* 9th edition. Crenshaw AH, ed. Mosby, St. Louis: 1998, 2579–2630.

Repair of Nonunion/Malunion of Proximal Third of Femur, Proximal Femoral Osteotomy for Osteoarthritis

Surgical Considerations

Description: Operations for nonunion/malunion of the proximal femur entail realigning the bones with a femoral osteotomy (as necessary); stabilizing the reduction with internal fixation (using a nail/plate-nail/rod device); and supplementing this with a bone graft. In young patients (< 50 yr) in whom early osteoarthritis of the hip spares some of the cartilage, the hip may be realigned with **proximal femoral osteotomy.** This entails cutting the bone at the level of the lesser trochanter, realigning the hip and stabilizing the osteotomy with internal fixation.

Variant procedure or approaches: Osteotomy of proximal 1/3 of femur for degenerative arthritis of hip

Usual preop diagnosis: Nonunion/malunion of proximal 1/3 of femur; early degenerative arthritis of hip

Summary of Procedures

	Repair Nonunion/Malunion	Proximal Femoral Osteotomy
Position	Supine or lateral decubitus	
Incision	Proximal lateral thigh	
Special instrumentation	Plates, screws; reduction clamps; occasionally, an intramedullary device. Cell Saver recommended. Some surgeons use fracture or radiolucent table with I.I.	

Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)	
Surgical time	2 h for bone grafting alone; 3 h or more if difficult malunion	3 h
EBL	500–750 mL or more	500 mL +
Mortality	Rare: < 1%	
Morbidity	Leg-length discrepancy: Common Technical complications/fixation failure: 1–5% Superficial, deep infection/osteomyelitis: 1% Malunion: Not uncommon Compartment syndrome: Rare Neurological deficit to peripheral nerves: Rare	–
	Vascular complications: Rare	Progressive pain/arthritis (by 5–10 yr): 40–50% Delayed union: 5–10% Nonunion: 1–5%
Pain score	8	8

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Patient Population Characteristics

Age range	Any age	
Male:Female	1:1	
Incidence	Rare	
Etiology	Previous surgery (rare); previous trauma (rare)	Early degenerative arthritis of the hip (not uncommon)
Associated conditions	May accompany multiple traumas	

Anesthetic Considerations

See Anesthetic Considerations for Lower-Extremity Procedures (p. 1059).

Suggested Readings

1. Barr RJ, Santore RF: Osteotomies about the hip. In *Chapman's Orthopaedic Surgery,* Vol 3, 3rd edition. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 2723–68.

2. Kyle RF, Schmidt AH, Campbell SJ: Complications of the treatment of fractures and dislocations of the hip. In *Complications in Orthopaedic Surgery,* 3rd edition. Epps CH Jr, ed. JB Lippincott, Philadelphia: 1994, 443–86.

3. LaVelle DG: Delayed union and nonunion of fractures. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998, 2579–2630.

4. Whittle AP: Malunited fractures. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1994, 2537–78.

Closed Reduction and External Fixation of Femur

Surgical Considerations

Description: This procedure entails manipulating the femur to obtain an acceptable reduction by closed or limited-open means, then applying an external fixation device to maintain the reduction. The pins for the external fixator are inserted percutaneously or through small incisions. This method of treatment may be used for severe open fractures (e.g., grade III) with extensive bone and soft-tissue injury.

Usual preop diagnosis: Displaced, open fracture of the femur

Summary of Procedures

Position	Supine or lateral
Incision	Done percutaneously or through small incisions
Special instrumentation	External fixation device of surgeon's choice; radiolucent table with I.I.
Unique considerations	Fracture is usually an open, extremely comminuted fracture in a multiple-trauma patient.
Antibiotics	Cefazolin 1 g iv q 6–8 h × 24 h (vancomycin or clindamycin for 24 h if penicillin allergic)
Surgical time	1 h
EBL	Operative blood loss usually 100–200 mL; however, blood loss may be extensive before surgery.
Postop care	Multiple-trauma victims → ICU; others → PACU
Mortality	Dependent on extent of trauma
Morbidity	Refracture: 2–12% Hypotension 2° blood loss and other injuries: Common Stiffness of knee: Common Delayed union, nonunion, malunion: More common in comminuted, open fractures Leg-length discrepancy: More common in severely comminuted fractures Osteomyelitis: More common in open fractures Respiratory distress: More common in multiple-trauma situations Amputation: Rare Compartment syndrome: Rare Neurological deficit to peripheral nerves: Rare Vascular complications: Rare
Pain score	9–10 (due to extensive open fracture)

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Patient Population Characteristics

Age range	Any age, but predominance of males < 30 yr
Male:Female	5:1
Incidence	Common
Etiology	Motorcycle and motor vehicle accidents; falls; industrial injury

Associated conditions	Frequently associated with trauma to other organ systems, including head and neck, chest, abdomen, and extremities; these will often be treated simultaneously with the femur fracture.

Anesthetic Considerations

See Anesthetic Considerations for Lower-Extremity Procedures (p. 1059).

Suggested Readings

1. Azer SN, Rankin EA: Complications of femoral shaft fractures. In *Complications in Orthopaedic Surgery,* 3rd edition. Epps CH Jr, ed. JB Lippincott, Philadelphia: 1986, 487–524.

2. Bucholz RW, Brumback RJ: Fractures of the shaft of the femur. In *Rockwood and Green's Fractures in Adults,* 4th edition. Rockwood CA Jr, Green DP, Bucholz RW, et al., eds. JB Lippincott, Philadelphia: 1996, 1827–1918.

3. Chapman MW: Diaphyseal fractures of the femur. In *Chapman's Orthopaedic Surgery,* Vol I, 3rd edition. Chapman MW, ed. Lippincott Williams & Wilkins, Philadelphia: 2001, 671–708.

4. LaVelle DG: Delayed union and nonunion of fractures. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1998, 2579–2630.

5. Whittle AP: Malunited fractures. In *Campbell's Operative Orthopaedics,* Vol 3, 9th edition. Crenshaw AH, ed. CV Mosby, St. Louis: 1994, 2537–78.