CQ HAND + UPPER LIMB
SPECIALIST ORTHOPAEDIC SURGEON

EVIDENCE SUMMARY

Periprosthetic fracture (hip)

Overview

- Recent epidemiologic studies indicate that the rise in the incidence of femoral neck fractures may be reaching a plateau or even declining [1].
- Femoral neck fractures will continue to form a considerable component of the orthopedic trauma workload for the foreseeable future [1].
- There is a general consensus that patients with undisplaced intracapsular fractures should be treated with fixation [1].
- Cannulated screw fixation has equivalent results to sliding hip screw devices for undisplaced intracapsular fractures [1].
- There is no convincing evidence supporting an advantage for implant designs using locking plate technology over other fixation methods for undisplaced intracapsular fractures [1].
- The weight of evidence strongly supports the use of arthroplasty as the treatment of choice for the majority of patients with displaced femoral neck fractures [1].
- A physiologically young patient with good bone stock who understands the risks of fixation is an exception to the preference for arthroplasty in displaced femoral neck fractures [1].
- A cemented hemiarthroplasty is a good choice for the elderly frail patient with a displaced femoral neck fracture [1].
- Better functional outcomes and lower revision rates are achieved with total hip arthroplasty (THA) in the fit older patient with a displaced femoral neck fracture [1].
- Fixation remains the treatment of choice for younger patients with displaced femoral neck fractures [1].
- Arthroplasty merits consideration for younger patients with displaced femoral neck fractures who have significant medical comorbidities [1].
- Future trials are expected to provide information on the results of newer designs of modern uncemented prostheses [1].
- Additional clinical research is required to provide evidence on arthroplasty choices, such as anterior versus posterior approaches, to determine which yield the best functional outcome and lowest economic tariff and surgical comorbidity [1].

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- A randomized controlled trial compared bipolar hemiarthroplasty with total hip replacement for displaced intracapsular fractures of the femoral neck in 120 patients with a mean age of 81 years [1].

Anatomy & Pathophysiology

BONY ANATOMY

- The hip is a multiaxial joint formed by the articulation between the pelvis and femur, connecting the axial skeleton and the lower extremity [11].
- The hemipelvis comprises three bones: the ilium, ischium, and pubis, which unite at the triradiate cartilage within the concave acetabulum [11].
- The acetabulum comprises an articular crescent-moon–shaped lunate surface and a nonarticular central fossa that serves as the attachment point for the ligamentum teres [11].
- The acetabulum is incomplete inferiorly, forming a notch through which vital blood vessels and nerves pass to supply the joint [11].
- The femoral head forms two-thirds of a sphere, with a small depression at its center from which the ligamentum teres extends to connect to the acetabular notch [11].
- The neck-shaft angle of the femur averages 125° [11].
- Normal version, defined as the head-neck angle in the frontal plane, averages 15 to 20° [11].
- At the junction of the neck and shaft are the greater and lesser trochanters, connected by the intertrochanteric line anteriorly and the intertrochanteric crest posteriorly [11].
- The two prime trabecular groups of the proximal femur are the principal tensile group and the principal compressive group [17].
- The weakest area in the femoral neck is located in the Ward triangle [17].
- The calcar femorale is a medial area of dense trabecular bone that transfers stress from the femoral shaft to the inferior portion of the femoral neck [17].
- Fractures of the proximal femur follow the path of least resistance [17].
- The subtrochanteric portion of the femur contends with the highest compressive and tensile forces in the human skeleton [23].

SOFT TISSUE ANATOMY

- The acetabular labrum is a fibrocartilaginous ring attached to the rim of the acetabulum that extends the articulating surface area and increases femoral head coverage [11].
- The labrum is triangular in cross section, which contributes to its ability to create a pressurized seal of the central compartment of the hip during loading [11].
- Only the external one-third of the labrum contains blood vessels, leaving the majority of the structure avascular and limiting its healing ability following injury [11].

- The labrum is absent in the area of the inferior acetabular notch, where the transverse acetabular ligament serves as the continuation of the labrum [11].
- The hip is surrounded by a dense fibrous capsule extending from the periphery of the acetabulum to the intertrochanteric line of the femoral neck [11].
- The capsule enhances joint stability by preventing translation of the femoral head in the acetabulum [11].
- The iliofemoral ligament is Y-shaped and is the thickest and strongest of the three main ligaments supporting the hip [11].
- The iliofemoral ligament functions to limit external rotation, while its lateral arm limits extension of the joint [11].
- The ischiofemoral ligament extends from the ischial margin of the acetabulum to the greater trochanter and restricts internal rotation motion [11].
- The pubofemoral ligament extends from the obturator crest of the pubic bone to the femoral neck and acts to limit abduction of the joint [11].
- Deep fibers from the iliofemoral, ischiofemoral, and pubofemoral ligaments merge to form the zona orbicularis, which circumvents the femoral neck [11].
- The hip capsule attaches anteriorly and posteriorly along the periphery of the acetabulum outside the labrum [12].
- Inferiorly, the hip capsule is attached to the acetabular labrum [12].
- The capsule is attached to the femur anteriorly along the intertrochanteric crest, but on the posterior side it attaches only partially, leaving the basicervical region of the femoral neck and the intertrochanteric region extracapsular [12].
- The iliofemoral ligament becomes taut in full extension, preventing anterior dislocation and hyperextension of the hip [12].
- The twisted orientation of the hip ligaments provides a screw mechanism for the hip in full extension [12].
- The ligamentum teres originates in the cotyloid fossa and attaches on the fovea of the femoral head [12].

VASCULAR ANATOMY

- The medial femoral circumflex artery is the main blood supply to the femoral head [17].
- The lateral femoral circumflex artery gives rise to the anterior aspect of the extracapsular arterial ring [17].
- The superior and inferior gluteal arteries contribute branches to the extracapsular arterial ring [17].
- The ascending cervical arteries originate from the extracapsular arterial ring and are divided into lateral, medial, posterior, and anterior groups [17].
- The lateral group of ascending branches is the main blood supply to the femoral head [17].
- The lateral epiphyseal artery penetrates the femoral head and is believed to be the dominant blood supply to the femoral head from the ascending cervical system [17].
- Fractures that disrupt the ascending blood flow to the lateral epiphyseal vessel have an increased risk of osteonecrosis [17].

- The artery of the ligamentum teres arises from either the obturator or medial femoral circumflex artery and does not provide sufficient blood supply to maintain the viability of the femoral head [17].
- In adulthood, the major blood supply to the femoral head is from the medial femoral circumflex and lateral epiphyseal arteries [20].
- From birth to approximately 4 years of age, the major blood supply to the femoral head comes from the medial and lateral femoral circumflex arteries with major contributions from the artery of the ligamentum teres [20].
- From the age of 4 years to adulthood, the posterosuperior and posteroinferior retinacular arteries from the medial circumflex artery are the major blood supply [20].

MUSCULAR ANATOMY

- The primary hip flexor muscles are the iliopsoas, rectus femoris, and sartorius muscles [15].
- The gluteus maximus and hamstring muscles are the most important hip joint extensors [15].
- The abductors of the hip are predominantly the gluteus medius and minimus muscles [15].
- The gluteus medius and minimus muscles function together to maintain and abduct the femur during the stance phase of gait [15].
- The external rotators of the hip include the obturator internus and externus, superior and inferior gemelli, quadratus femoris, and piriformis muscles [15].
- The piriformis forms the reference structure for the posterior part of the hip, with structures identified by whether they originate above or below it [15].
- The superior gluteal nerve and artery exit the pelvis above the piriformis muscle [15].
- The sciatic nerve, inferior gluteal nerve, and inferior gluteal artery exit the pelvis below the piriformis muscle [15].
- In 10% of cases, the common peroneal component of the sciatic nerve can pass through the division in the piriformis [15].
- The most consistent internal rotators of the hip joint are the gluteus medius and tensor fascia latae muscles [15].

PATHOPHYSIOLOGY

- Femoral neck fractures are considered intracapsular fractures and are at higher risk of nonunion due to the absence of a periosteal or extraosseous blood supply [17].
- Intertrochanteric fractures are considered extracapsular fractures, and nonunion is rare because of the presence of an abundant blood supply [17].
- Significant fracture displacement in the subtrochanteric region occurs secondary to the pull of the iliopsoas, gluteus medius, and short external rotators on the proximal fracture segment [23].
- The pull of these muscles places the proximal subtrochanteric segment into a position of flexion, abduction, and external rotation relative to the distal segment [23].

- The unopposed pull of the adductors on the distal segment often leads to femoral shortening in subtrochanteric fractures [23].
- Comminution of the medial cortex in subtrochanteric fractures increases the demand of the fixation construct, surpassing loads of 1,200 lbs per square inch in a 200-lb person [23].
- Varus malreduction leads to increased mechanical stress on the fixation construct by altering the weight-bearing force vector through the proximal segment [23].
- Hip microinstability refers to femoral head micromotion within the acetabulum, which is a prolonged phenomenon that leads to cartilage damage and eventually osteoarthritis of the hip [21].
- The hip joint is stable due to ball-and-socket bony anatomy and soft-tissue constraints including the labrum, capsule, and ligamentum teres [21].

Classification

ACETABULAR FRACTURES (PAPROSKY)

- The Paprosky classification categorizes periprosthetic acetabular fractures into five main types: intraoperative during implant insertion, intraoperative during implant removal, traumatic, spontaneous, and pelvic discontinuity [2].
- Type I (intraoperative during implant insertion) is subdivided into IA (recognized, stable, nondisplaced), IB (recognized, unstable, displaced), and IC (unrecognized) [2].
- Type II (intraoperative during implant removal) is subdivided based on bone stock loss, with subtypes defined by less than 50% or greater than 50% bone stock loss [7].
- Type III (traumatic) is subdivided into IIIA (stable component) and IIIB (unstable component) [2].
- Type IV (spontaneous) is subdivided into IVA (associated with loss of <50% acetabular bone stock) and IVB (associated with loss of >50% acetabular bone stock) [2].
- Type V (pelvic discontinuity) is subdivided into VA (loss of <50% bone stock), VB (loss of >50% bone stock), and VC (associated with prior pelvic radiation) [2].
- The Paprosky classification for periprosthetic acetabular fractures summarizes treatment recommendations based on implant stability, fracture displacement, and available bone stock [7].

FEMORAL FRACTURES (VANCOUVER)

- The Vancouver classification is the current standard for assessing and reporting periprosthetic femoral shaft fractures about hip arthroplasty stems [6].
- The Vancouver classification considers the location of the fracture relative to the stem, the stability of the implant, and associated bone loss [6].
- Type A fractures are located in the trochanteric region [6].
- Type B fractures involve the area of the stem [6].
- Type C fractures are located distal to the tip of the stem [6].

- Type A fractures are subdivided into AG (greater trochanter) and AL (lesser trochanter) [6].
- Type B fractures are subdivided into B1 (stable implant), B2 (loose implant), and B3 (bone loss and usually a loose implant) [6].
- The intraoperative Vancouver classification divides fractures into three zones: type A (proximal metaphysis without extension to diaphysis), type B (diaphyseal about the tip of the stem), and type C (extending beyond the longest revision stem) [6].
- Intraoperative Vancouver subtypes I, II, and III represent simple cortical perforation, nondisplaced linear cortical crack, and displaced or otherwise unstable fracture, respectively [6].
- The original Vancouver classification was developed for postoperative fractures but has been expanded to address intraoperative periprosthetic femur fractures [6].
- Vancouver type B fractures are defined as occurring about the distal tip of the stem [7].
- Vancouver type C fractures are treated independently of the hip prosthesis, except regarding the overlap of the fixation device and the prosthesis [6].

Clinical Presentation

- Postoperative periprosthetic acetabular fracture should be suspected if groin pain is present after trauma [2].

Investigations

CLINICAL EXAMINATION

- A thorough history is essential for differentiating between common causes of hip pain [3].
- Clinical examination tests and imaging findings should be used to confirm a suspected clinical diagnosis [3].
- Patients with femoroacetabular impingement (FAI) frequently present with activity-related groin pain exacerbated by hip flexion activities [5].
- Patients with FAI exhibit restricted hip internal rotation in 90° of flexion [5].
- The impingement test (flexion, adduction, internal rotation) elicits pain in patients with FAI, but the test is not specific for FAI [5].
- The impingement test involves hip flexion to 90 degrees followed by hip adduction and internal rotation to yield a pain response [34].
- The Stinchfield test involves active straight-leg raise of approximately 20 cm against mild resistance, with pain felt in the anterior hip [34].
- The Patrick test involves positioning the leg in a figure-of-four position, with pain elicited in the anterior or posterior hip region [34].
- Pain located over the posterior pelvis during the Patrick test indicates referred pain from L5 to S1 facets or the sacroiliac joint, not the hip joint [34].

RADIOGRAPHY

- Conventional radiographs remain critical in the initial imaging evaluation of the hip [4].
- A complete hip series usually consists of an anterior-posterior (AP) pelvis, a centered AP hip, a lateral view (frog-leg, cross-table, Dunn 45° or 90°), and a false-profile (Lequesne) view [4].
- Radiographs can be used to diagnose fractures, developmental dysplasia of the hip (DDH), femoroacetabular impingement (FAI), and osteoarthritis [4].
- Acetabular morphology is assessed on AP pelvis radiographs to evaluate overcoverage and undercoverage [4].
- The femoral head-neck junction morphology is often assessed using the alpha angle [4].
- Some studies have shown that radiographs, particularly the Dunn 45° view, may be more accurate for determining the alpha angle measurement than CT or MRI [4].
- The Tönnis angle is defined by the angle of the acetabular sourcil and a line parallel to the transverse pelvis axis, with values between 0° and 10° considered normal [4].
- The lateral center-edge angle of Wiberg is the angle between a line from the center of the femoral head perpendicular to the transverse pelvis axis and a second line from the center of the femoral head to the superolateral most point of the acetabulum [4].
- Center-edge angles of 20°–40° are considered normal, while angles from 20° to 25° are considered borderline [4].
- The femoral head extrusion index is defined by the length of the femoral head that lies beyond the acetabulum as a percentage of the total horizontal width of the femoral head, with values greater than 25% considered abnormal [4].
- Coxa profunda is diagnosed when the fossa line touches or is medial to the ilioischial line on an AP pelvis radiograph [4].
- Radiographs remain integral to the assessment of fractures and can be supplemented with CT to investigate suspected occult fractures, define fracture morphology, and assist in preoperative planning [4].
- Radiographs can serially assess hardware positioning and evaluate symptomatic hardware related to open reduction and internal fixation and total hip arthroplasty [4].
- Standard AP radiographs of the hip and pelvis are obtained to examine bony architecture, check for evidence of joint space narrowing or changes to bone quality, and quantify femoral head coverage [25].
- The Dunn view and frog leg view are appropriate to measure the α angle to determine the presence of impingement [25].
- Anteroposterior (AP) and lateral radiographs are required for the evaluation of femoral neck fractures [32].
- In the majority of cases, the diagnosis of a femoral neck fracture is clear on the AP radiograph [32].
- The lateral radiograph is useful in determining whether a femoral neck fracture is present and whether it is displaced [32].
- Full-length AP and lateral femur films are standard for the evaluation of femoral neck fractures [32].

COMPUTED TOMOGRAPHY

- CT overcomes the limitations of radiography by providing three-dimensional assessment of bony morphology and, to some degree, assessment of soft-tissue abnormalities [13].
- CT is helpful in fracture evaluation, particularly in the setting of negative radiographs or for further defining fracture morphology in patients requiring surgical reduction [13].
- CT scans are effective for examining cortical and cancellous bone and can be used to create three-dimensional reconstructions of the hip for use in surgical planning [25].
- Measurements of femoral head coverage and acetabular and femoral impingement can be performed reliably using CT images [25].
- Low-dose CT with three-dimensional reformats is particularly useful in surgical planning of complex or borderline deformities [5].
- Three-dimensional CT with pelvic remodeling may be indicated for preoperative planning for reconstruction associated with dysplasia surgery, femoroacetabular impingement (FAI), posttraumatic arthritis, or other complex primary total hip arthroplasty (THA) [34].
- Thomas et al. reported 100% specificity and sensitivity for the use of multidetector CT scanning in diagnosis of hip fracture in a series of 209 patients with negative plain radiographs [32].
- Rehman et al. reported on 179 patients presenting with pelvic pain after trauma and found that imaging with CT missed no occult hip fracture [32].
- Sadozai et al. reported on 78 CT scans and found that CT scanning yielded a sensitivity of 86% and specificity of 98% [32].
- Sadozai et al. suggested MRI scanning would be preferred as the imaging of choice for cases with suspected fracture but normal or equivocal plain radiographs [32].

MAGNETIC RESONANCE IMAGING

- MRI is the modality of choice for patients suspected of soft tissue or intra-articular pathology, given its superior sensitivity and specificity [25].
- Conventional MRI is effective at identifying osteochondral injuries, musculotendinous pathologies, and inflammation [25].
- Magnetic resonance arthrography (MRA) is more appropriate to determine injuries to the labrochondral structures and the ligamentum teres and identify the presence of loose bodies and synovial chondromatosis [25].
- The utility of MRA in the accurate detection and staging of articular cartilage lesions is reduced, with sensitivity reported to be less than 50% compared with arthroscopic findings [25].
- Recent advances in MRI imaging techniques, such as delayed gadolinium-enhanced MR imaging and T2* mapping, allow for a more in-depth analysis of the structure of articular cartilage [25].
- Delayed gadolinium-enhanced MR imaging and T2* mapping were effective at detecting early changes to the articular cartilage surfaces of patients with hip dysplasia and femoroacetabular impingement [25].
- MRI provides information regarding the integrity of the acetabular labrum and articular cartilage [5].

- The anatomy of the proximal femur as well as the version of the acetabulum and femur may be assessed using MRI [5].
- Sensitivity of MRI to acetabular rim chondral lesions is limited [5].
- MRI is used when osteonecrosis is suspected [34].
- Gadolinium-enhanced MRI arthrogram is useful when labral pathology is suspected, especially when associated with FAI [34].
- MRI may identify gluteus medius and gluteus minimus tears in patients with lateral hip pain and abductor weakness [34].
- MRI is helpful in identifying femoral neck stress fracture in athletes and predicting patients that may require surgical intervention [30].
- MRI is helpful in assessing complications of conventional and resurfacing hip arthroplasties, particularly those with metal-on-metal bearing systems [30].
- Major findings on MRI that help predict histologic ALVAL scores include synovial thickening, synovitis, synovial volume, abductor disruption, and soft-tissue edema [30].
- Haubro et al. compared use of CT and MRI in 67 patients with pelvic pain after trauma who had normal radiographs and found the MRI scan was more accurate in detecting occult hip fractures [32].
- Collin et al. came to the same conclusion as Haubro et al. in a smaller study of 44 patients imaged with both CT and MRI [32].
- MRI has been shown to be more accurate than a bone scan in the early stages after injury and there is no radiation [32].
- MRI will demonstrate soft tissue problems that may be causing hip pain in the absence of a fracture [32].
- An MRI scan is the current additional imaging modality recommended where there is uncertainty about the presence of an intracapsular fracture [32].
- Noncontrast MRI at 3T is generally adequate for diagnosing intra-articular pathology [30].
- If 3T imaging is unavailable, MRA can be considered at 1.5T for increased diagnostic accuracy [30].
- A prospective study compared noncontrast 3T MRI to 1.5T MRA and found similar accuracies between the two techniques [28].
- A retrospective study evaluated the accuracy of noncontrast 3T MRI versus hip arthroscopy and found accuracy for labral tears and acetabular cartilage lesions was 98% and 90%, respectively [28].
- Positron emission tomography/computed tomography (PET/CT) at 6 weeks could detect recovery of vascularity and could predict the risk of vascular necrosis [32].
- Dynamic MRI–positive enhancement integral color mapping (PEICM) was evaluated in 68 patients due to undergo osteosynthesis of undisplaced femoral neck fractures [32].
- In the PEICM study, the nonunion rate was zero in the normal perfusion group, 6.7% in the reduced perfusion group, and 50% in the absent perfusion group [32].

ULTRASONOGRAPHY

- Ultrasonography provides real-time dynamic assessment of the hip and is useful in diagnosing soft-tissue abnormalities about the hip joint [13].
- Ultrasonography is particularly useful in providing real-time guidance during diagnostic and therapeutic procedures [13].
- Although ultrasonography is a valuable tool to examine pediatric hip conditions, its utility in evaluating the adult hip is limited [25].
- Ultrasonography can be an effective modality to identify musculotendinous disruptions, effusions associated with intra-articular pathology, or inflammatory conditions, such as bursitis [25].
- Ultrasonography is increasingly used for targeted injections into muscles, tendons, or intra-articularly around the hip for use with corticosteroids or biologic treatments [25].
- Ultrasonography allows bedside evaluation of the hip and can be used to guide interventions in the office setting [30].

NUCLEAR MEDICINE

- A technetium bone scan is often considered a useful investigation in cases where there is a suspected fracture but normal or equivocal plain radiographs [32].
- A technetium bone scan is usually positive in cases with a femoral neck fracture, but there is the possibility of a false negative in osteopenic bone if the investigation is carried out within 48 to 72 hours of the fall [32].
- A technetium bone scan is sensitive but not specific for femoral neck fractures [32].

Treatment

ACETABULAR PERIPROSTHETIC FRACTURES

- For Paprosky Type IA periprosthetic acetabular fractures (intraoperative, recognized, nondisplaced, stable component), the cup is left in place and augmented with multiple screws through the cup [2].
- Protected weight bearing for 8 to 12 weeks should be considered for Paprosky Type IA periprosthetic acetabular fractures [2].
- For Paprosky Type IB periprosthetic acetabular fractures (intraoperative, recognized, displaced), the cup should be removed and the displaced fragment fixed with bone screws [2].
- A buttress plate is used for Paprosky Type IB periprosthetic acetabular fractures if the posterior column is involved [2].
- For Paprosky Type IB periprosthetic acetabular fractures, reaming is performed close to the component size to minimize underreaming before the component is impacted back into position [2].
- A multipole revision acetabular implant and protected weight bearing for 8 to 12 weeks should be considered for Paprosky Type IB periprosthetic acetabular fractures [2].

- Management of Paprosky Type IC periprosthetic acetabular fractures (intraoperative, unrecognized) is the same as that performed for type III, IV, and V fractures [2].
- For Paprosky Type II periprosthetic acetabular fractures (intraoperative during implant removal), a large revision acetabular implant with multiple screws may be used if 50% of the remaining host bone retains structural integrity and areas of primary support for the cup remain intact [2].
- For Paprosky Type IIIA periprosthetic acetabular fractures (traumatic, stable component), the cup is left in place and protected weight bearing for 8 to 12 weeks should be considered [2].
- For Paprosky Type IIIB periprosthetic acetabular fractures (traumatic, unstable component), revision to a porous revision acetabular implant with multiple screws should be performed [2].
- If a posterior column fracture is present in Paprosky Type IIIB periprosthetic acetabular fractures, fixation with a pelvic plate and screws should be performed before acetabular implant insertion [2].
- For Paprosky Type IVA periprosthetic acetabular fractures (spontaneous, <50% bone stock loss), a large revision acetabular implant with multiple screws may be used and bone graft is used as needed [2].
- For Paprosky Type IVB periprosthetic acetabular fractures (spontaneous, >50% bone stock loss), bulk allograft or metallic augmentation are used to manage the bone defect [2].
- A cage or cup-cage construct is used for Paprosky Type IVB periprosthetic acetabular fractures if the host bone is insufficient to allow bone ingrowth [2].
- For Paprosky Type VA periprosthetic acetabular fractures (pelvic discontinuity, <50% bone stock loss), the posterior column fracture is fixed with a pelvic plate and screws before acetabular implant insertion [2].
- For Paprosky Type VA periprosthetic acetabular fractures, revision to a porous revision acetabular implant with multiple screws should be performed and bone graft is used to repair the fracture site [2].
- Protected weight bearing for 8 to 12 weeks should be considered for Paprosky Type VA periprosthetic acetabular fractures [2].
- For Paprosky Type VB periprosthetic acetabular fractures (pelvic discontinuity, >50% bone stock loss), the discontinuity is fixed using a pelvic plate and screws [2].
- For Paprosky Type VB periprosthetic acetabular fractures, bulk allograft or metallic augmentation should be used to manage the bone defect [2].
- A cemented acetabular implant, cage construct, or custom triflange component that spans from the ilium to the ischium should be used for Paprosky Type VB periprosthetic acetabular fractures [2].
- For Paprosky Type VC periprosthetic acetabular fractures (pelvic discontinuity associated with prior pelvic radiation), a cemented acetabular implant, cage construct, or custom triflange component that spans from the ilium to the ischium should be used [2].
- The capability of a porous cup to heal the fracture and achieve biologic fixation is very poor in Paprosky Type VC periprosthetic acetabular fractures [2].
- For unstable, intraoperative acetabular fractures, upsizing to a larger cup may provide a stable construct [7].
- If cup stability is questionable in unstable, intraoperative acetabular fractures, an additional posterior column buttress should be provided via a reconstruction plate [7].

- For periprosthetic acetabular fractures with an obviously loose cup, a thorough CT assessment should be performed to determine the amount of associated bone loss and location of fracture lines [7].
- The surgeon should have a low threshold for revision to a jumbo cup and for the use of a cage construct to help re-create a stable acetabular side depending on the amount of bone loss [7].

FEMORAL PERIPROSTHETIC FRACTURES

- Vancouver Type A fractures are located in the trochanteric region [6].
- Vancouver Type B fractures involve the area of the stem [6].
- Vancouver Type C fractures are distal to the tip of the stem such that their treatment is considered independent of the hip prosthesis [6].
- Vancouver Type AG fractures are fractures of the greater trochanter [6].
- Vancouver Type AL fractures are fractures about the lesser trochanter [6].
- Vancouver Type B1 fractures are associated with a stable implant [6].
- Vancouver Type B2 fractures are associated with a loose implant [6].
- Vancouver Type B3 fractures are associated with bone loss and usually a loose implant [6].
- Intraoperative testing of implant stability and preparation for dealing with a loose stem are prudent when distinguishing a well-fixed from a loose implant in the setting of periprosthetic fracture [6].
- For Vancouver Type AL fractures, symptomatic treatment is preferred unless substantial medial cortex is involved [6].
- For Vancouver Type AG fractures, symptomatic treatment or ORIF with a claw plate is preferred to treat pain, weakness, or instability [6].
- For Vancouver Type B1 fractures, a lateral plate is applied with biologic fracture reduction techniques [6].
- For Vancouver Type B2 fractures, an uncemented revision long stem with or without a lateral plate is the preferred treatment [6].
- For Vancouver Type B3 fractures, long stem revision with allograft with or without a lateral plate or revision to a tumor prosthesis is the preferred treatment [6].
- For Vancouver Type C fractures, a distal femoral locking plate extending proximal to overlap the femoral stem is the preferred treatment [6].
- Intraoperative Vancouver Type A1 fractures (metaphyseal cortical perforation) are treated with protected weight bearing or bone graft [6].
- Intraoperative Vancouver Type A2 fractures (metaphyseal undisplaced crack) are treated with protected weight bearing or cerclage cables [6].
- Intraoperative Vancouver Type A3 fractures (metaphyseal displaced or unstable) are treated with ORIF with a claw plate with conversion to a long stem if the implant is unstable [6].
- Intraoperative Vancouver Type B1 fractures (diaphyseal cortical perforation) are treated with a cortical strut with or without conversion to a long stem [6].

- Intraoperative Vancouver Type B2 fractures (diaphyseal undisplaced crack) are treated with a lateral plate with conversion to a long stem if the implant is unstable [6].
- Intraoperative Vancouver Type B3 fractures (diaphyseal displaced or unstable) are treated with a lateral plate with conversion to a long stem if the implant is unstable [6].
- Intraoperative Vancouver Type C1 fractures (distal to stem cortical perforation) are treated with a cortical strut [6].
- Intraoperative Vancouver Type C2 fractures (distal to stem undisplaced crack) are treated with protected weight bearing or a lateral plate [6].
- Intraoperative Vancouver Type C3 fractures (distal to stem displaced or unstable) are treated with a lateral plate [6].
- Intraoperative identification of periprosthetic femur fractures generally leads to more surgical interventions than identification in the recovery room or later [6].
- Intraoperative fractures that occur about the trochanters can typically be addressed with cerclage wiring [7].
- If the calcar is fractured or unstable in trochanteric periprosthetic fractures, subsidence and subsequent instability may result and lead to dislocation or potential implant instability [7].
- The surgeon should have a low threshold for changing the femoral stem to a calcar-replacing diaphyseal fitting or a modular diaphyseal fitting stem if the calcar is fractured or unstable [7].
- Many postoperative fractures about the trochanters are often minimally displaced and can be managed nonsurgically with motion restriction [7].
- With substantial displacement of postoperative trochanteric periprosthetic fractures, nonunion can occur and surgical fixation with a trochanteric grip plate (with or without cerclage wires) is recommended [7].
- If there is any possibility that the stem is loose in trochanteric periprosthetic fractures, revision is recommended [7].
- If there is a greater trochanteric fracture with concomitant lesser trochanteric involvement, there should be high suspicion for potential implant loosening because the fracture line may be continuous and hidden by the implant on plain radiographs [7].
- Vancouver type B fractures generally require surgical management [7].
- Definitive classification of stem stability for Vancouver type B fractures is usually made intraoperatively [7].
- Provisions should be made for fixation and implant revision for Vancouver type B fractures [7].
- Preoperative assessment of the acetabular implant should be performed for periprosthetic femoral fractures [7].
- The surgeon should have a low threshold for cup revision to obtain longevity of the hip when managing periprosthetic femoral fractures [7].
- Fractures about a hemiarthroplasty can be managed based on the femoral-side recommendations for a total hip arthroplasty [7].
- Fractures about a resurfaced hip typically occur about the femoral neck and require revision to total hip arthroplasty [7].

- Femoral shaft fractures around, above, or below stable hip replacements often require plate fixation of the femoral shaft [43].
- Plate fixation is indicated for fractures at or near previously placed implants, such as periprosthetic or peri-implant fractures [43].
- Severe osteoporosis with concern for screw purchase in the bone is a relative contraindication to plate fixation of femoral shaft fractures [43].
- Bicortical locking screws may be of benefit for plate fixation in patients with severe osteoporosis [43].

GENERAL PERIOPERATIVE MANAGEMENT

- Comanagement care teams should be used in the care of hip fracture patients to decrease complications and improve outcomes [36, 37].
- Preoperative traction should not be routinely used for hip fracture patients [36, 37].
- Venous thromboembolism (VTE) prophylaxis should be used for hip fracture patients [36, 37].
- Definitive treatment in 24 hours is associated with a reduced 30-day and 1-year mortality for hip fracture patients [36, 37].
- An echocardiogram during the preoperative evaluation increases the time to surgery for hip fracture patients [36, 37].
- It is recommended to operate early despite recent antiplatelet drug use for hip fracture patients [36, 37].
- Spinal or general anesthesia is appropriate for hip fracture surgery, with spinal anesthesia avoided in patients with severe aortic stenosis [36, 37].
- Multimodal analgesia incorporating preoperative nerve block is recommended for hip fracture patients [36, 37].
- Tranexamic acid (TXA) should be administered to reduce blood loss and transfusions in hip fracture patients [36, 37].
- It is acceptable to restart bisphosphonates 1 week postoperatively for hip fracture patients [36, 37].
- Delirium is associated with increased length of stay in hip fracture patients [36, 37].
- The goal of treatment for hip fractures is to allow early weight bearing to minimize complications [36, 37].
- Mortality risk is reduced if surgery is performed within 48 hours for intracapsular femoral neck fractures [36, 37].
- Stable fixation and early mobilization are general principles for the treatment of intracapsular femoral neck fractures [36, 37].
- Nonoperative treatment is indicated for nondisplaced hip fractures in patients able to comply with weight-bearing restrictions [36, 37].
- Nonoperative treatment is indicated for displaced hip fractures in patients with extremely limited functional demands and/or those with high risk for surgery [36, 37].
- Touch down weight bearing for 6 to 8 weeks is prescribed for nonoperative treatment of hip fractures [36, 37].

- Internal fixation is indicated for Garden types I and II intracapsular femoral neck fractures [36, 37].
- Three parallel screws are used for Garden types I and II and occult intracapsular femoral neck fractures [36, 37].
- The starting point for screw fixation distal to the lesser trochanter should be avoided due to an associated increased risk of peri-implant subtrochanteric fracture [36, 37].
- Varus malreduction is correlated with failure of fixation following cannulated screw fixation of femoral neck fractures [36, 37].
- Sliding hip screw devices may have a higher avascular necrosis (AVN) risk than cannulated screws for intracapsular femoral neck fractures [36, 37].
- Internal fixation of intracapsular femoral neck fractures is associated with a high failure rate of up to 30% [36, 37].
- The failure rate of internal fixation is higher in intracapsular femoral neck fractures with sagittal plane deformity (retroversion) [36, 37].
- The typical treatment for failure of internal fixation of intracapsular femoral neck fractures is arthroplasty [36, 37].
- Hemiarthroplasty is indicated for displaced intracapsular femoral neck fractures in elderly patients with low functional demands [36, 37].
- Hemiarthroplasty has a lower risk of dislocation than total hip arthroplasty (THA), especially in patients unable to comply with dislocation precautions [36, 37].
- A cemented femoral component is recommended when treating femoral neck fractures with hemiarthroplasty [36, 37].
- Functional results of unipolar and bipolar prostheses are similar for hemiarthroplasty of femoral neck fractures [36, 37].
- Total hip arthroplasty (THA) is indicated for “active” elderly patients with displaced intracapsular femoral neck fractures and provides the best functional outcome [36, 37].
- THA is preferred to hemiarthroplasty for patients with preexisting hip arthropathy (osteoarthritis and rheumatoid arthritis) and has been shown to provide the best hip function after displaced femoral neck fracture [36, 37].
- THA has a higher dislocation rate than hemiarthroplasty for displaced femoral neck fractures [36, 37].
- Preinjury cognitive function and mobility predict postoperative functional outcome for hip fracture patients [36, 37].
- The 1-year mortality rate in elderly patients with hip fractures is approximately 30% [36, 37].
- Appropriate identification of associated medical comorbidities, medical and orthopaedic comanagement, and prompt surgical treatment may minimize the risks of complications, morbidity, and mortality while improving outcomes for intertrochanteric hip fractures [38].
- The implant choice for intertrochanteric hip fractures should be based on fracture pattern, cost, and the surgeon’s familiarity [38].

- The goal of implant selection for intertrochanteric hip fractures is to deliver patient-appropriate care in a timely manner [38].
- One-year mortality rates after intertrochanteric hip fracture are between 10% and 30% [38].
- The most important orthopedic aspect of treating a trochanteric fracture is the quality of the surgery, particularly fracture reduction and implant positioning [39].
- There has to be a concentration of hip fracture patients in centers with the necessary equipment and expertise to address difficult trochanteric fracture patterns or patient characteristics [39].
- Modifications to the design of the sliding hip screw may have produced marginal benefits with the reduced blood loss with the percutaneous compression plate for trochanteric hip fractures [39].
- Trochanteric side plates may be of value in reverse oblique trochanteric fractures [39].
- Intramedullary fixation methods appear to offer the most potential for trochanteric hip fractures, with some studies now reporting improved function with these devices [39].
- Operative time and surgical trauma may be reduced by the less invasive surgery of intramedullary fixation for trochanteric hip fractures [39].
- With the development of new implants for trochanteric hip fractures, there is a need for continuous evaluation ideally within the context of carefully conducted randomized trials [39].
- Large database monitoring is required to determine the less common implant-related complications of trochanteric hip fracture fixation [39].

· Considerable improvements have been made in the management of trochanteric hip fractures over the past 40 years, with greater use of earlier, less invasive surgery combined with early mobilization [39].

Complications

- General and hip-specific complications are included in outcome measurements for displaced intracapsular fractures of the femoral neck [1].
- Surgical comorbidity is a factor considered when selecting arthroplasty approaches such as anterior versus posterior [1].

References

[1] Rockwood And Green S Fractures In Adults. 51: Hip Dislocations and Femoral Head Fractures > Summary, Controversies, and Future Directions Related to Femoral Neck Fractures.

[2] Aaos Comprehensive Orthopaedic Review 3. Periprosthetic Fractures Associated With Total Hip and Knee Arthroplasty > I. Total Hip Arthroplasty.

[3] Orthopaedic Knowledge Update 13 Ebook Without Multimedia. Anatomy and Biomechanics, Evaluation, Clinical Examination, and Imaging of the Hip > Summary.

[4] Orthopaedic Knowledge Update Sports Medicine 6. Imaging of the Hip > Radiography.

[5] Aaos Comprehensive Orthopaedic Review 3. Nonarthroplasty Surgical Treatment of the Hip > I. Femoroacetabular Impingement.

[6] Rockwood And Green S Fractures In Adults. Mechanisms of Injury for Distal Femur Fractures > Periprosthetic Femur Fractures About Hip Arthroplasty Prostheses > Classification of Periprosthetic Femur Fractures About Hip Arthroplasty Prostheses.

[7] Orthopaedic Knowledge Update Trauma. Periprosthetic Fractures > Lower Extremity Periprosthetic Fractures > Hip Arthroplasty.

[11] Orthopaedic Knowledge Update 13 Ebook Without Multimedia. Anatomy and Biomechanics, Evaluation, Clinical Examination, and Imaging of the Hip > Osseous and Ligamentous Anatomy.

[12] Aaos Comprehensive Orthopaedic Review 3. Surgical Anatomy of the Hip > IV. Hip Capsule and Ligaments.

[13] Orthopaedic Knowledge Update Sports Medicine 6. Imaging of the Hip > Introduction.

[15] Aaos Comprehensive Orthopaedic Review 3. Surgical Anatomy of the Hip > V. Hip Joint Muscles.

[17] Aaos Comprehensive Orthopaedic Review 3. Fractures of the Hip > I. General Considerations.

[20] Aaos Comprehensive Orthopaedic Review 3. Surgical Anatomy of the Hip > VI. Neurovascular Structures Surrounding the Hip.

[21] Orthopaedic Knowledge Update Sports Medicine 6. Hip Microinstability > Introduction.

[23] Rockwood And Green S Fractures In Adults. 51: Hip Dislocations and Femoral Head Fractures > Pathoanatomy and Applied Anatomy Relating to Subtrochanteric Femur Fractures.

[25] Orthopaedic Knowledge Update 13 Ebook Without Multimedia. Anatomy and Biomechanics, Evaluation, Clinical Examination, and Imaging of the Hip > Imaging.

[28] Orthopaedic Knowledge Update Sports Medicine 6. Imaging of the Hip > Annotated References.

[30] Orthopaedic Knowledge Update Sports Medicine 6. Imaging of the Hip > Summary.

[32] Rockwood And Green S Fractures In Adults. 51: Hip Dislocations and Femoral Head Fractures > *Imaging and Other Diagnostic Studies for Femoral Neck Fractures*.

[34] Miller S Review Of Orthopaedics. SECTION 16 PATELLAR TRACKING IN TOTAL KNEE ARTHROPLASTY > SECTION 1 EVALUATION OF THE ADULT PATIENT WITH HIP PAIN.

[36] Miller S Review Of Orthopaedics. SECTION 16 PATELLAR TRACKING IN TOTAL KNEE ARTHROPLASTY > GERIATRIC HIP FRACTURES.

[37] Miller S Review Of Orthopaedics. GERIATRIC HIP FRACTURES.

[38] Orthopaedic Knowledge Update Trauma. Intertrochanteric Hip Fractures in the Geriatric Population > Summary.

[39] Rockwood And Green S Fractures In Adults. 51: Hip Dislocations and Femoral Head Fractures > Summary, Controversies, and Future Directions Related to Trochanteric Hip Fractures.

[43] Rockwood And Green S Fractures In Adults. 51: Hip Dislocations and Femoral Head Fractures > Indications/Contraindications > Plate Fixation of Femoral Shaft Fractures: Indications and Contraindications.

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