Femoral Fractures

Fractures of the femur are common. They may affect the neck, shaft or distal (supracondylar) femur. They include:

- Fractures of the femoral neck - far more common in the elderly.
- Fractures of the femoral shaft and supracondylar fractures - usually caused by violent trauma and most often occur in adolescents and young adults.
- Femoral stress fractures - partial-thickness fractures, most commonly affecting the femoral neck. They are chronic overuse injuries and tend to be seen in those who take part in physical activity. They may progress to full fractures. They are covered more fully in the separate Stress Fractures article.

Hip fractures

A hip fracture means a fracture of the proximal femur (proximal to 5 cm below the lesser trochanter). Hip fractures are the most common reason for admission to an orthopaedic trauma ward.[1]

Intracapsular fractures

Involve the femoral neck between the edge of the femoral head and insertion of the capsule of the hip joint.

- Around half of all hip fractures are intracapsular.
- Intracapsular fractures may disrupt the blood supply to the femoral head, leading to avascular necrosis.

Extracapsular trochanteric fractures

Distal to the insertion of the capsule, involving or between the trochanters.

- They include intertrochanteric or pertrochanteric and reverse oblique fractures and isolated trochanteric avulsion fractures.
- Isolated trochanteric avulsion fractures can result from sudden violent force avulsing the insertion of gluteus medius from the greater trochanter, or iliopsoas from the lesser trochanter.

Extracapsular subtrochanteric fractures

Fractures below, but no more than 5 cm below, the lesser trochanter, ie involving the proximal femoral shaft, at, or just distal to, the trochanters.

Causes of hip fracture

- Hip fractures can follow relatively minor trauma (eg, a fall, or a direct blow to the side of the hip) in the elderly, those with osteoporosis and those with metastatic disease..
- In younger patients hip fractures are usually caused by high-energy trauma and are often associated with other serious injuries.[2]

Risk factors

- Increasing age.
- Osteoporosis.
- Osteomalacia.
- Falls, which may be secondary to a number of factors which are often age-related including:
  - Instability.
  - Lack of core strength.
  - Gait disturbance.
  - Sensory impairment.

Presentation

- Pain is typically in the outer upper thigh or in the groin.
- Pain may radiate to the knee (isolated knee pain can occasionally be the only symptom).
- Inability to bear weight.
- There may be no history of injury, especially in an elderly patient with confusion or dementia.
- Pain may be particularly aggravated by flexion and rotation of the leg.
- The affected leg may be shortened, adducted and externally rotated.
- Where there is a preceding stress injury or bone pathology (eg, metastasis) there may be a preceding history of aching in the groin or thigh.

Diagnosis

- Anteroposterior (AP) pelvic and lateral hip X-rays: may show disruption of trabeculae, inferior or superior cortices and abnormality of pelvic contours.
Shenton's line is a radiographic, curved line formed by the top of the obturator foramen and the inner side of the neck of the femur. It is used to determine the relationship of the head of the femur to the acetabulum. This line is broken in fractures.

Magnetic resonance imaging (MRI) should be performed if a hip fracture is suspected but AP pelvic and lateral hip X-rays don't show a fracture. If MRI is not available within 24 hours or is contra-indicated (e.g., due to a pacemaker) then computerised tomography (CT) should be requested.

Intracapsular neck of femur fractures are graded by various classifications, including Garden's classification:
- Garden I: trabeculae angulated, inferior cortex intact. No significant displacement.
- Garden II: trabeculae in line but a fracture line is visible from superior to inferior cortex. No significant displacement.
- Garden III: obvious complete fracture line with slight displacement and/or rotation of the femoral head.
- Garden IV: gross, often complete, displacement of the femoral head.

Assessment
Initial Investigations should include:
- General workup including FBC and cross match, renal function, glucose, ECG and, if indicated, CXR, intravenous access with intravenous infusion if indicated.
- Analgesia should be adequate for the patient and should enable the movements necessary for investigations and for nursing care and rehabilitation.
- Non-steroidal anti-inflammatory drugs (NSAIDs) are not recommended.
- Early assessment for cognitive impairment and treatable comorbidities - e.g., anaemia, volume depletion, electrolyte imbalance, acute confusional states, uncontrolled diabetes, uncontrolled heart failure, cardiac ischaemia, arrhythmia, chest infection.

Management
Intracapsular fractures
- Surgery should be performed within one day of admission.
- Undisplaced fractures need internal fixation with screws (arthroplasty is considered for those patients who are less fit).
- Displaced intracapsular fractures should be treated by replacement of the femoral head with an arthroplasty, if the person is fit for the procedure: internal fixation is associated with less initial operative trauma but has an increased risk of re-operation on the hip.
- Scottish Intercollegiate Guidelines Network (SIGN) guidance states that patients with pre-existing joint disease, medium or high activity levels and a reasonable life expectancy should have a total hip replacement rather than hemiarthroplasty as primary treatment.
- The National Institute for Health and Care Excellence (NICE) recommends:
  - Replacement arthroplasty (hemiarthroplasty or total hip replacement) for patients with a displaced intracapsular fracture.
  - Total hip replacements for patients with a displaced intracapsular fracture who:
    - Are able to walk independently out of doors with no more than the use of a stick; and
    - Are not cognitively impaired; and
    - Are medically fit for anaesthesia and the operation.

Extracapsular fractures
- Extracapsular hip fractures are treated surgically unless there are medical contra-indications.
- They are usually treated by internal fixation but hip arthroplasty may be used (internal fixation may fail, especially for unstable fractures).
- There are no significant differences in outcome between conservative and operative management for extracapsular fractures but operative treatment is associated with a reduced length of hospital stay and improved rehabilitation.
- Both intramedullary and extramedullary internal fixation have been advocated for the treatment of subtrochanteric femoral fractures. There is some evidence that operation time and fixation failure are reduced with the use of intramedullary implants.
- NICE recommends extramedullary implants such as a sliding hip screw in preference to an intramedullary nail in patients with trochanteric fractures above and including the lesser trochanter.

Complications
Mortality following hip fractures is high. About 10% of people with a hip fracture die within one month and about one third within 12 months. Complication rates are higher in elderly patients. Most deaths are due to associated co-morbidities.
- Infection.
- Haemorrhage.
- Avascular necrosis.
- Delayed union, malunion and non-union.
- Pneumonia.
- Myocardial infarction.
- Stroke.
- Deep vein thrombosis and pulmonary embolus.
- Pressure ulcers.

Femoral shaft fractures
Fractures of the femoral shaft are caused by a high-energy injury, such as a road traffic accident, unless a pathological fracture in a patient with osteoporosis or metastatic disease. They are often associated injuries to the hip, pelvis, knee and other parts of the body.

- Fractures vary in degree and complexity, depending on the degree of force involved. They may be:
  - Transverse (horizontally across the shaft).
  - Oblique.
  - Spiral, due to a twisting force.
  - Comminuted (when there are three or more resulting bone pieces).
  - Open or closed.

- Fractures of the distal third of the femur are termed supracondylar fractures and can affect the knee joint. They are considered at the bottom of this article.

**Diagnosis**

- Severe pain, with supporting history of injury.
- Tense, swollen, tender thigh.
- Inability to bear weight.
- Deformity and shortening on the affected side.

**Investigation**

- Assess vital functions and any associated chest, head, abdominal or spinal injuries. Resuscitate and treat life-threatening injuries as necessary.
- Splint fractures (Thomas’ splint or equivalent traction splint).
- X-rays of the femur: AP and lateral views of the entire femur and the ipsilateral knee and hip (it is important to rule out co-existing femoral neck fracture).
- CT may be considered in mid shaft fractures, also to rule out femoral neck fracture.

**Management**

**Initial management**

- Blood tests, including blood for cross-matching and assessment of general condition.
- Intravenous access and fluid replacement.
- Analgesia: adequate intravenous analgesia. Femoral nerve block is usually effective.
- Peripheral sensation and pulses should be closely monitored.

**Further management**

- Patients are usually treated with open or closed reduction. The limb is immobilised with a plaster or splint and possibly also with internal or external fixings. X-rays are used to verify the alignment of the bone and assess progress towards healing.\[9\]
- Intramedullary nailing is the most common fixation method. This involves placing a rod in the femoral bone marrow, crossing the fracture site, with intramedullary nails screwed to the bone at both ends.
- Surgery is not usually repeated in cases of delayed union but is normally needed in cases of non-union. It usually involves internal or external fixation and bone grafting (harvested from the iliac crest).
- EXOGEN is a low-intensity pulsed ultrasound system licensed for healing non-union fractures (for which it is recommended by NICE). It is claimed to promote bone healing by stimulating the removal of old bone, increasing the production of new bone and increasing the rate at which the fibrous matrix at the fracture site is mineralised.\[10,11\]
- Early immobilisation and treatment reduce the risk of complications. NICE recommends physiotherapy assessment and, unless medically or surgically contra-indicated, mobilisation on the day after surgery. Patients should be offered mobilisation at least once a day and regular physiotherapy review.\[1\]
- Most femoral shaft fractures take 4-6 months to heal completely. Open fractures and complex comminuted fractures can take longer.
- In patients with multiple comorbidities and a non-displaced fracture, a long leg cast is an alternative, less invasive management approach.

**Complications**

**Early complications**

- Neurovascular damage from sharp bone ends.
- Closed fractures may be involve a large volume of blood loss before becoming obvious with swelling of the thigh.
- Acute compartment syndrome.
- Open fractures have a high risk of complicating infection.
- Problems with union: 5-10% of femoral shaft fractures do not heal as expected: delayed union is the term used for when there is no radiological evidence of healing within three months of fracture. Non-union is the term used for when nine months have elapsed since the original fracture, with no visible signs of healing in the preceding three months.\[11\]

**Later complications**

- Fat embolism.
- Deep vein thrombosis.
Pulmonary embolism.
Infection.
Shortening, angulation, malalignment.
Delayed union and non-union.
Hardware irritation.

About a quarter of patients with hip fracture are admitted from institutional care and about 10-20% of those admitted from home ultimately move to institutional care. [1]

Supracondylar fractures

- Fractures of the distal third of the femur usually occur as a result of direct trauma.
- They are often comminuted and often intra-articular with associated damage to the knee joint. See also separate Knee Fractures and Dislocations article.
- The distal fragment of the femur tends to pulled backwards and the popliteal artery may be damaged.
- Initially, treatment is the same as for fractures of the femoral shaft but a femoral nerve block is not as effective and so additional analgesia is required.
- Treatment for undisplaced fractures: often conservative with skeletal traction with the knee in 30° of flexion.
- Displaced intra-articular fractures require internal fixation.

Further reading & references

1. Hip fracture: NICE Clinical Guideline (June 2011)
4. Management of hip fracture in older people; Scottish Intercollegiate Guidelines Network - SIGN (June 2009)
10. EXOGEN ultrasound bone healing system for long bone fractures with non-union or delayed healing; NICE Medical Technology Guidiance, January 2013

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