Fractures around the proximal femur are a common injury, particularly as a fragility fracture in the elderly. In the younger patient they usually signify a significant degree of trauma and are much less common. There are three fracture patterns which you should know; intracapsular, intertrochanteric and subtrochanteric. It is important to consider pathological fractures in the proximal femur as it is a common site of metastasis and it is prudent to maintain a degree of suspicion in any patient with a known diagnosis of malignancy and a hip fracture.

Anatomy
The key to understanding the management of these fractures is to understand the anatomy of the bone and blood supply in the region. The x-ray below shows the major bony anatomy.

All fractures of the neck disrupt the intramedullary blood supply. If a fracture is displaced it will either kink or disrupt the supply from the capsular retinaculum leaving only the tenuous or possibly absent supply from the ligamentum teres. Without an adequate blood supply the femoral head will undergo avascular necrosis (AVN).

Intracapsular Fractures
Intracapsular fractures are commonly referred to as a neck of femur fracture or ‘NOF’. As the name suggests they occur at the level of and proximal to the capsular insertion on the femoral neck. The image below shows the insertion of the hip capsule. On the right is an x-ray taken after radio-opaque dye was injected into the hip capsule which nicely shows its outline.

Typically patients sustaining a neck of femur fracture are elderly patients who present with a history of a low velocity injury, such as a fall from standing height. These patients often have osteoporosis or a lytic lesion, weakening the bone leading to a pathological fracture.
Less commonly younger patients under the age of 50 will sustain such an injury. In these cases the mechanism is almost invariably high impact trauma. Patients like this must be assessed for other injuries according to ATLS® principles, as their femur fracture will often not be an isolated injury.

Neck of femur fractures are classified according to the Garden system. This grades them from 1 - 4, based on an increasing degree of displacement. The grades are:

Garden 1: This is an incomplete fracture of the femoral neck where the head has tilted into a valgus position.

Garden 2: There is a complete fracture across the femoral neck but it is completely undisplaced.

Garden 3: In this pattern there is a complete fracture which is displaced though there remains some continuity between the fracture ends. This can be seen as the head remains tilted.

Garden 4: There is again a complete fracture but there is no continuity between the fracture ends and the femoral head comes back to rest in its neutral position.

The following diagram shows examples of each fracture pattern.

A fracture could quite easily look undisplaced on an AP view but in reality be posteriorly displaced as shown below.

This lateral reveals significant displacement which has clearly disrupted the blood supply to the femoral head. Any attempt to fix this fracture would be inadvisable as the patient will inevitably go on to develop avascular necrosis.

The management of intracapsular fractures therefore depends on the degree of displacement and to a degree the fitness of the patient. The basic principle is based on the rhyme; “One and two; use a screw. Three and four; Austin Moore”. What this means is that undisplaced fractures should be fixed and displaced fractures should be replaced, usually with a hemiarthroplasty (the Austin Moore is an early design of hemiarthroplasty).

Cannulated Hip Screws
The commonest way of fixing an undisplaced fracture is to use cannulated hip screws. These are long screws with a hole running through the middle of them. They allow guide wires to be used to get the best position and can then be screwed on over the top of the wires. The x-ray below shows them in situ.

Three screws are usually used. Two superiorly and one inferiorly. There are in fact two superior screws on the above x-ray but they are perfectly superimposed and so the posterior superior one is not visible.
**Hemiarthroplasty**

As we have said displaced fractures should be replaced. The implant of choice is the hemiarthroplasty. There are four broad types of hemiarthroplasty. Two stem variants; cemented and uncemented and two head variants; unipolar and bipolar. The picture below shows a unipolar head above and a bipolar head below.

The unipolar head and stem form a single block which moves as one. The bipolar head has a built in articulation which allows the head to move independently of the stem.

The use of uncemented stems is uncommon due to problems with the stem sinking and fractures being caused when they are inserted. Therefore the majority you will see are cemented. The x-ray below shows a cemented bipolar hemiarthroplasty.

**The Young Hip Fracture Patient**

Without complicating things too much, there are two caveats to the management of intracapsular fractures as described above. Displaced fractures in a fit young patient (in the second to fifth decade of life) should be fixed within 6 hours rather than replaced. The rationale for this is that while there is a high risk of avascular necrosis, to insert a joint replacement in someone of this age is a last resort as it will almost certainly need multiple revision surgeries as the total hip replacement wears out. Each revision will be more complex and have a poorer outcome. It could also be argued that because the patient is young and fit, should avascular necrosis occur after the fracture is fixed, they would be able to tolerate revision to total hip replacement much better than an older patient who should have a single definitive procedure.

The second caveat is that fit patients between the ages of 40 and 60 would do poorly with a hemiarthroplasty as they still have a high functional demand. These patients should be treated with a total hip replacement which has much better functional outcomes.

**Intertrochanteric Fractures**

This category includes all fractures which occur between the trochanters. They are therefore extracapsular and pose little threat to the blood supply of the femoral head. Their management is fixation rather than replacement. The following x-ray shows a typical intertrochanteric fracture.

The fracture line can be seen running from the greater to the lesser trochanter. It is common for these fractures to be multifragmentary, with the lesser and sometimes the greater trochanter being separate fragments. The next x-ray shows a four part intertrochanteric fracture.
These fractures are generally treated with a compression hip screw (CHS). A common type of CHS is the dynamic hip screw (DHS). The first stage of the operation is to reduce the fracture on a traction table in theatre. When a satisfactory position is obtained, a guide wire is positioned with x-ray guidance through the neck and into the head. Then a hole is reamed into which is inserted a large neck screw. A plate is fitted over the screw (the two are not directly attached). The plate is then screwed onto the shaft of the femur. The following sequence of x-rays were taken in theatre showing these stages.

In this example an additional cannulated screw has been positioned above the DHS, though this is not always done. The x-ray below shows a DHS in situ.

Subtrochanteric Fractures

These fractures occur below the trochanters and so are also extracapsular. They tend to occur in two circumstances. The first is high energy trauma. The second is as a consequence of lytic lesions which are present in the subtrochanteric region weakening the bone. They are sometimes seen as fragility fractures in the elderly. As with intertrochanteric fractures, they do not compromise the blood supply to the femoral head and so fixation is the treatment of choice. An intramedullary nail with a hip screw such as the gamma nail is typically used.

The x-ray below shows a subtrochanteric fracture. The predominant fracture is below the level of the trochanters, through there are extensions to both the greater and lesser trochanters.

The reason the neck screw is not attached to the plate directly explains the name of the device. When the patient puts weight through the hip the neck screw transmits the force through the fracture and to the plate. This compresses the fracture which aids the healing process. The picture below shows the implant itself.
The following x-ray shows the above fracture fixed with a gamma nail.

The nail itself extends the whole length of the femur. In contrast to the compression hip screw, the neck screw on this implant is fixed to the nail and is not ‘dynamic’.