Common traumatic hip (coxofemoral) joint injuries to be covered in this lecture include:

- Coxofemoral luxations
- Fractures of the proximal femur
  - femoral head and neck
  - greater trochanter
  - capital physeal dysplasia (Slipped capital epiphysis)
- Fractures of the acetabulum

A) Coxofemoral luxations

Coxofemoral luxations are the most common luxation encountered in general practice with vehicle trauma accounting for between 59%-83% of cases [1-2]. Most commonly these are unilateral and in a craniodorsal direction (others are ventral and caudal and maybe associated with concurrent avulsion fracture of the greater trochanter). Luxation occurs with loss of two or more of the primary stabilisers of the hip joint (joint capsule, teres ligament and dorsal acetabular rim). Soft tissue injuries surrounding the joint are common and it is important to assess for concomitant injuries elsewhere (such as thoracic or abdominal injuries) given the severity of the trauma needed to induce luxation.

Treatment is aimed at reducing the luxation whilst minimising damage to the articular surface. The luxation needs to be stabilised in situ in order to allow the surrounding soft tissues to heal. This may be achieved in a closed manner and stabilised with an Ehmer sling, although chronic cases will need open surgical management. If the luxation is irreparable or if too much damage to the articular surface is evident a femoral neck and head excision (FHNE) (or a total hip replacement (THR)) may be required.

78% of coxofemoral luxatuions are in a craniodorsal direction [1]. The head of the femur comes to rest dorsal and cranial to the acetabulum. In this position the limb appears shorter and the stifle is externally rotated. Clinically this can be assessed by palpating a combination of the greater trochanter, ischiatic tuberosity and the ilial wing. In a normal joint this forms a triangle. When the hip is luxated a straight line (or even an inverted triangle is palpable).

Although hip luxations may be apparent on clinical examination, the diagnosis should be confirmed with radiography. Orthogonal (lateral and VD pelvis) views should be taken in order to rule out concomitant injuries (e.g. fracture of the femoral neck). This is also particularly important in those breeds predisposed to hip dysplasia. Severely affected joints will make reduction and maintenance of the reduction difficult and may alter your decision making.

Treatment

**Closed reduction:** Simple luxations can be managed by closed reduction if treated within 4-5 days of the luxation. After this time other factors such as muscle contracture and soft tissue infiltration of the acetabulum may limit the ability to reduce the luxation and, more so, maintain the reduction afterwards.

Theoretically three types of tear to the joint capsule exist [3] which affect the efficacy of closed reduction. In practice the clinician should assess the ease with which the luxation is reduced and the stability of the joint post reduction. Careful consideration should be given to those which are easily
reduced or feel very unstable post reduction. If doubt exists then an open reduction with ancillary stabilisation should be considered.

With the animal anaesthetised in lateral recumbency with the affected limb uppermost, a rope is passed under the limb into the inguinal region and held by an assistant stood at the dorsum of the patient. With one hand on the greater trochanter and a firm grasp around the hock the stifle is inwardly rotated. An alternative method is to externally rotate the femur, followed by traction and internal rotation to allow the femoral head to pass over the ilium. In both cases this is followed by abduction of the pelvic limb with firm pressure on the greater trochanter to try and seat the head. A pop may be felt as reduction occurs. With pressure applied to keep the femoral head seated, the hip is flexed and extended to eject blood clots, joint capsule and granulation tissue from the joint. A mediolateral/ventrodorsal radiograph should always be obtained following reduction. Reluxation can be up to 50% therefore closed reduction is often augmented with an Ehmer sling, Hobbles (for ventral/caudoventral luxations), DeVita pin, external fixators, transarticular pinning.

An Ehmer sling can be applied for between 7-14 days. Failure rates of between 47-71% are reported for this technique; being greater if placed greater than 5 days post injury [1-2]. If the hip stays reduced for 3 weeks the prognosis is excellent. Complications secondary to the Ehmer sling are common and cases should be regularly monitored for signs of sores. Cats with coxofemoral luxations are generally candidates for surgical management as they poorly tolerate bandages.

**Open Reduction and stabilisation:** Numerous techniques are reported for stabilising coxofemoral luxations following open reduction (Capsulorraphy, prosthetic capsule technique, transarticular pinning, toggle rod, extra-articular iliofemoral suture, femoral head and neck excision, total hip replacement (THR)). For the purposes of this lecture we will concentrate on the following techniques:

- Extra-articular iliofemoral suture [4]
- Transarticular pin [5-6]
- Femoral head and neck excision[7]
- THR [8]

A craniolateral approach to the hip is made as described by Piermattei [9]. Dissection is made easier if the hip can be reduced prior to making the approach. A partial tenotomy of the middle gluteal muscle can be made to increase the exposure of the joint (see lecture). Haematomas, joint capsule and avulsed fragments of bone should be removed from the joint prior to reduction. If insufficient bone stock is present to allow long term reduction then a FHNE or THR should be considered.

**Transarticular pin:** After making the approach the femur is externally rotated to expose the femoral head (a closed insertion can also be used). The important part of this technique is to ensure the pin exits the femoral head at the fovea. A 2mm pin is sufficient for most medium breed dogs (1.6mm for dogs 4-7kg and 3.2mm for dogs>30kg). For 2mm pin placement, a 1.6mm drill bit is used to retrograde drill the femur from the fovea exiting laterally on the femur. A C guide can be used to aim this drill although as long as the drill passes from the fovea and along the neck, the exact exit point on the femur is not critical. A 2mm pin is then passed in a normograde direction through the drill hole. At this point the femoral head remains luxated so the operator is able to observe the pin at the level of the articular cartilage. After reduction of the joint and with a small degree of INTERNAL rotation the pin is advanced until 2-3 mm protrudes medially to the acetabulum. The approximate distance required can be measured from the radiograph by measuring the depth of the acetabulum and can be further assessed using a non scrubbed assistant to feel the pin via rectal palpation. The pin is bent over and cut on the lateral aspect of the femur to facilitate easy removal after 4-6 weeks. Flexion and extension is possible with the pin in situ although abduction/ adduction are not.
Prognosis for this technique is good (80% success rate) but a second surgical procedure is required to remove the pin. Complications include pin bending and breakage, migration of the pin allowing relaxation and subluxation of the hip if the pin does not exit the fovea. More frequent problems are seen in dogs>20kg and those with hip dysplasia [10].

**Iliofemoral suture:** once the joint is reduced a transverse bone tunnel is drilled across the greater trochanter in a craniocaudal direction. A further lateromedial tunnel is drilled into the caudoventral ilial body just cranial to the acetabulum. Once the suture is passed through these tunnels it is tied with the limb held in internal rotation. The author’s preference is to secure the suture in a figure of 8 pattern although it can be tied as a loop if desired. Leader line is commonly used with sizes as follows

- Dogs less than 25kg – single 80lb strand
- Dogs 25-40kg – single 100lb strand
- Dogs over 40kg – double 100lb strand

These cases are rested for about a month and then exercise is gradually introduced. The suture internally rotates the limb (similar to an Ehmer sling) so the dog will walk with an awkward looking gait. This is not usually permanent as the suture will eventually snap and a normal gait will resume. One study reports no major complications or reluxations with this technique [11].

**Femoral head and neck excision:** This can be used in chronic luxation, severe fractures of the acetabulum or femoral head and neck, and chronic OA. It is indicated if there is severe damage to the femoral head and THR is not an option.

**THR:** Use of this procedure is indicated with chronic OA, recurrent luxation and chronic physeal fractures. It is an expensive procedure (£3500-4000 at UoL) but has an excellent success rate of 95% [8].

**B) Fractures of the proximal femur**

These fractures account for 25% of all proximal femoral fractures. In dogs, approximately 90% of these are in dogs<1 year old and 70% involve the capital physis.

- Capital and Capital (proximal) femoral growth plate (physis) (most common)
- Capital physeal dysplasia
- Femoral Neck (Cervical)
- Greater trochanter

**Epiphyseal (Capital) fractures:**

- Occur most often as a complication of coxofemoral luxation
- Avulsion of a bone fragment involving the teres ligament of the femoral head.
- Surgical treatment is required: primary excision arthroplasty in small dogs and cats, excision of fragments and treatment of luxation, lag screw fixation of fragments with countersunk screws or K wire fixation.
- May need augmentation to avoid luxation especially if there is a need to cut the teres ligament.
Capital (proximal) femoral physeal fractures:

- These occur in immature animals (4-7 months) as a result of trauma and can be bilateral.
- Animals present with pain on hip manipulation but often there is no crepitus. Some cases may have concurrent greater trochanter separation. Repair of these injuries should be performed within a few days. Conservative management is not recommended due to a poor functional outcome. Resorption of the femoral neck occurs in 70% cases - closed reduction with fluoroscopy has been reported to reduce this [12]
- Diagnosis involves history, clinical signs and radiography (VD and Lateral views of coxofemoral joints)
- The technique of choice is to place 2-3 parallel Kirschner (K) wires (0.7 to 1.6mm) using a cranialateral or dorsal approach to the hip. Other implants include Steimann pins (mid to large breed dogs) and bone screws.
- Implants can be placed either normograde (normograde with closed reduction is ideal) or retrograde (not ideal due to potential damage to blood supply). A C-shaped drill guide can be useful. Depth can be assessed with fluoroscopy or allow the pins to just penetrate the joint surface and with draw prior to bending and cutting the pins.

Figure 1: Treatment of capital femoral physeal fractures

Capital physeal dysplasia
Analogous to that found in children where a spontaneous unilateral and bilateral separation of the capital physis occurs after timely closure, capital physeal dysplasia (slipped capital femoral epiphysis) has been reported in small animals [13]. It occurs more commonly in cats, particularly young overweight neutered cats and may be associated with early neutering [14]. Lag screw application with an anti-rotational K-wire is recommended as well as FHNE.

Femoral neck (cervical) fractures:

- These fractures occur at the base of the neck at its junction with the metaphysis of the proximal femur.
- Occurs usually in dogs <1 year old and cats (3-5 times more common than capital physeal fractures in cats) following an RTA or fall.
- Surgical treatment with compression with lag screw and anti-rotational K wire or triangulation with diverging K wires
Fractures of greater trochanter:

- Avulsion fractures- treat accordingly with pin and tension band technique –as with repair of an osteotomy in this area. Experimentally this technique, as well as lag screw application, may contribute to shortening of the femur but clinically this does not seem to be a problem.
- Usually seen in combination with capital physeal fractures.
- Conservative management can be considered in it is minimally displaced.

NB: Comminuted fractures involving the femoral head and neck are challenging to repair but if fragments are large enough they may be repaired with lag screws and K wires. In some cases excision arthroplasty may be necessary.

C) Fractures of the acetabulum

General considerations:

- Craniodorsal two-thirds of acetabulum is currently thought to be main weight-bearing area of the hip; therefore even moderately displaced fractures in this area should be treated with open reduction and internal fixation. It was generally thought that fractures of the caudal third could be treated conservatively but some research has suggested that these cases have poor results [15].
- Aims of acetabular fracture surgical repair follow the AO/ASIF principles of anatomical reduction of articular surfaces, rigid fixation and early return to function.
- Types of fracture are transverse, oblique and comminuted and they occur though the dorsal rims at cranial, central and caudal sites.

Treatment

- Dorsal approach to hip including a trochanteric osteotomy or gluteal tenotomy (limited to young and small animals if possible) (see surgical texts for more detail)
- Plate fixation on the dorsal aspect of the acetabulum with a reconstruction or acetabular plate (these plates allow 3D contouring) is the preferred technique. Locking plates such as the locking compression plate (Synthes) or string of pearls plate (SOP) (Orthomed) may not require as accurate contouring as with the plates above.
- Other techniques used to repair these fractures are bone screws and polymethylmethacrylate (PMMA or “bone cement”), screws/ “K” wires and a tension band wire in small dogs and cats.
- Severely comminuted or unreconstructable fractures of the medial wall may not be repairable and may need a FHNE or total hip replacement, at a later date.

Post-operative care
Strict rest is required for all traumatic injuries for the first 4-6 weeks with short on-leads walks for toileting purposes. Analgesics such as NSAIDs, paracetamol and opioids, are important in the immediate post-operative period as well as soft bedding with pelvic fractures.
References: