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INTRA-ARTICULAR FRACTURES

U. Matis, Prof. Dr. med. vet. Dr. med. vet. habil. Dipl. ECVS
Clinic of Veterinary Surgery of the Ludwig-Maximilians-University, Veterinaerstrasse 13, 80539 Munich, Germany

Reconstructive surgeries still represent the treatment of choice for traumatic joint diseases and particularly for articular fractures. Early anatomically correct and stable reduction of fragments and application of careful soft tissue-sparing preparation techniques are mandatory for re-establishing joint congruency and also for rapid mobilization.

Fractures of the shoulder joint

Intra-articular fractures of the scapula include avulsion of the supraglenoid tuberosity and fractures of the glenoid cavity, which may be combined with fractures of the scapular neck. The approach varies according to the area involved. For avulsion fractures of the supraglenoid tuberosity, the use of small T-plates is recommended. Fractures involving the scapular neck and glenoid cavity are repaired using screws, Kirschner wires and/or bone plates. The surgeon must visualise the articular surface of the glenoid during the reduction and fixation procedure.

Fractures of the proximal humerus may be accompanied by foreleg paresis or paralysis resulting from nerve injury within the brachial plexus. Epiphyseal fractures are uncommon. Precise reduction should be accomplished, using a (cranio-) lateral approach. Internal fixation is carried out by the insertion of a lag screw and/or Kirschner wires. The majority of proximal humerus fractures are physeal separations. Fixation is accomplished using two Kirschner wires, which cross the physeal plate perpendicularly. Bone screws should be reserved for use in animals that are close to maturity, since premature closure of this physis can lead to disabling limb-shortening.

Fractures of the elbow joint

Supracondylar fractures of the humerus involve the humero-ulnar joint. Internal fixation is accomplished by the use of crossed pins, screws(s) or plate(s). The author prefers medial over caudal or lateral positioning of the plate. Bicondylar (Y or T) fractures also affect the humeroradial joint. The medial approach generally provides sufficient exposure for reconstruction. A combination of a medial and lateral approach may be necessary for small distal fragments. The trans-olecranon (caudal) approach should be reserved for comminuted or long-standing fractures, which necessitate a large exposure. Starting on the fracture surface of the medial humeral condyle, a glide hole is drilled, followed by precise anatomic reduction of the articular components. Using a drill guide, the thread hole is then drilled into the lateral condyle and a transcondylar cortical screw is inserted. Various methods are used to re-attach the condyles to the humeral shaft. With short distal segments, crossed pins (Kirschner wires) may be used, otherwise bone plate fixation is preferred. Lateral condylar fractures are repaired via a (cranio-) lateral approach avoiding injury to the radial nerve. In addition to a transcondylar lag screw, a Kirschner wire is drilled across the supracondylar fracture line to improve rotational stability. Medial condylar fractures of the humerus occur less frequently than lateral ones and are approached medially, sparing the ulnar nerve. In cases of long oblique fractures, several lag screws may be used; otherwise the same fixation technique as described for lateral condylar fractures is employed.
Fractures of the proximal ulna with dislocation of the radius can be repaired by use of an intramedullary pin in the ulna. In cases of ulnar fractures with dislocation of the radial head and separation of the radius and ulna (Monteggia fracture) the annular ligament is sutured or replaced after reconstruction of the ulna. In fractures of the anconeal process, early internal fixation using a lag screw inserted caudally, or two Kirschner wires, is preferred to excision. Additional ulnar lengthening may be required to re-establish normal articulation in the elbow joint.

Fractures of the radial head are very rare. Fixation depends on the type of injury. In young animals incongruity of the elbow joint may result from retardation of radial growth.

Fractures of the carpus
Fractures of the distal radial articular surface are treated by precise anatomic reduction and internal fixation using lag screws and/or Kirschner wires. Additional external support may be indicated. Fractures involving the styloid process of the ulna can be treated conservatively; however, with instability of the antebrachiocarpal joint, internal fixation using a plate or an intramedullary Kirschner wire is preferred. Young dogs should be re-evaluated at short intervals, because of the high risk of asynchronous growth of the radius and ulna. Fractures of the radial carpal bone are predominantly found in Boxers. In most cases, surgical repair is indicated using a lag screw inserted from the medial aspect of the bone. Fractures of the accessory carpal bone are most commonly seen in racing dogs as avulsions. There is little tendency for complete healing with conservative treatment. Fragments large enough to accept implants are fixed using 1.0, 1.5 or 2.0 mm screws. Fractures of the ulna and numbered carpal bones are rare. They usually come with small chips or slabs on the dorsal surface, which can be excised. Nondisplaced fragments may reattach and heal following splinting or casting of the carpus.

Fractures of the hip joint
Acetabular fractures constitute approximately 12 % of canine and 10 % of feline pelvic injuries. Conservative treatment by means of cage rest often results in disabling degenerative joint disease. Precise anatomical reduction and stable internal fixation are required for good long-term results. The Gorman approach provides good visualisation of the fracture area and adequate manoeuvrability for the fixation. The joint capsule often remains intact. It is incised longitudinally beginning at the fracture site and is directed towards the joint surfaces. Fixation is accomplished using precontoured plates. Prebending the plate on a bone of equivalent size shortens the time of surgery considerably by simplifying the reduction. Reconstruction plates are most suitable as they can be modelled 3-dimensionally. Pinning techniques are limited to long oblique fractures of the caudal acetabular area because the stability achieved by pins is less than that attained by the use of plates.

Fractures of the femoral head and neck including physeal separations typically occur at the onset of physeal closure. Epiphyseal fractures often accompany luxations and involve the avulsion of a piece of bone at the attachment of the ligament to the head. Small fragments that are not part of the weight-bearing surface may be removed during open reduction of the hip joint. If the fracture segment is large enough to hold implants, fixation is indicated. In mature animals, small cortical lag screws are inserted in the femoral neck, whereas in growing dogs and cats, Kirschner wires are preferred. Separations of the capital physis are intracapsular fractures. They should only be repaired using Kirschner wires because the extensive trauma caused by the insertion of
screws provokes premature closure of the physis. To ensure rotational stability, two Kirschner wires are necessary. Neck fractures run intra- and/or extracapsularly. They may be stabilised either by two Kirschner wires or by lag screw fixation. The screw threads should purchase only in the proximal fragment, in order to ensure compression at the fracture line. Any rotational instability should be prevented by an additional Kirschner wire.

The prognosis is favourable with early anatomic reduction, gentle tissue handling to preserve the blood supply and stable internal fixation. Persistent avascular necrosis of the femoral head as seen in human patients does not appear to be a common complication in small animals.

**Fractures of the stifle joint**

Fractures affecting the stifle joint may be found in the distal end of the femur, the proximal end of the tibia and the patella. **Distal fractures of the femur** require internal fixation. Lag screws are generally recommended for stabilisation of condylar fractures. For the repair of supracondylar and physeal fractures, various methods – such as intramedullary pinning, plate fixation, the use of a diagonally placed lag screw, a tension band wire technique or just Kirschner wires (crossed or paired) – are used depending on the type of fracture and the surgeon’s preference. Internal fixation of physeal fracture-separations should be as non-disruptive as possible to the growth plate. Two thin Kirschner wires crossing the physis perpendicularly provide good stability without impairment of growth.

**Proximal fractures of the tibia** can sometimes be treated conservatively. However, in most cases internal fixation is indicated. Plates may be considered in unstable metaphyseal fractures, and lag screw fixation is the method of choice in condylar fractures. In displaced fracture-separations of the epiphysis and avulsion of the tibial tuberosity, Kirschner wires are advocated.

**Patellar fractures** may indicate the removal of a fragment, patellectomy or the use of a tension band wire technique. Disruption of the quadriceps mechanism requires additional external fixation.

**Fractures of the tarsus**

The most common tarsal fractures are malleolar. Intraperiosteal injuries without displacement respond well to conservative treatment. Otherwise, internal fixation using a tension band wire is the method of choice. This technique is also the best treatment for proximal fractures of the calcaneus. In intra-articular fractures of the calcaneal base, stabilisation with a plate may be considered; non-dislocated cases can even be treated conservatively. Fractures of the talus are predominantly found in cats. Best results are achieved by reconstructing the articular surface evenly. Small fragments can be removed provided that joint stability is not compromised. In irreparable extensive joint lesions, an arthrodesis should be considered. Fractures of the central tarsal bone seldom occur except in the racing dog. Fixation is done by one or two lag screws depending on the type of injury. Comminuted fractures may require stabilization using a small buttress plate.

Fractures of numbered tarsal bones are very rare. Some of these are best treated by internal fixation and/or excision of smaller fragments, whereas others heal well with a splint or cast.
Long-term results of 120 cats and 190 dogs with surgically treated articular fractures of the shoulder, elbow, and stifle that were re-evaluated clinically and radiographically after an average of 5 years, revealed an incidence of arthrosis of 40 to 90% and an incidence of lameness of 20 to 40% (1, 2). In cats, degenerative changes affected mainly the stifle joint, whereas in dogs the hip joint was most commonly affected. The type of fracture and degree of displacement had a greater influence on the outcome than the time of surgical intervention. For all the joints, arthrosis of the elbow had the most detrimental effect on joint function. Also, trauma of the tarsal joint often resulted in disabling secondary arthrosis (3, 4, 5, 6). In this respect, concomitant ligament lesions have a significant influence on the clinical outcome.

Further Readings: