



# **Arthrodesis Masterclass for Advanced Practitioners Mini Series**

**Session Three: Arthrodesis of the  
shoulder, elbow and stifle**

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## Arthrodesis of the shoulder, stifle and elbow

**Shoulder arthrodesis** is uncommonly performed, although can be indicated in non-reconstructable articular fractures, shoulder luxation (recurrent or congenital) and end stage osteoarthritis. Despite some expected gait alteration – circumduction during protraction of the limb, limb function which is achieved is generally acceptable. This is in part likely due to the muscular attachment of the scapula to the thorax, which provides some recompense for the loss of shoulder joint mobility.

A cranio-lateral approach to the shoulder is required as is osteotomy of the greater tubercle of the humerus and acromion of the scapula, although an insertional tenotomy of the supraspinatous and infraspinatous muscles and myotomy / tenotomy of the acromial head of the deltoid muscle could be performed as alternatives. Care must be taken to preserve the suprascapular nerve as it courses over the scapular notch. Removal of the articular cartilage can be achieved either with a high speed bone burr preserving the normal articular contour or by partial ostectomy of the scapular glenoid and humeral head, to create two parallel bony surfaces which can be compressed together. Although the application of bone graft is recommended in arthrodesis surgery, exposure of a large surface area of cancellous bone with the ostectomy technique may make it unnecessary, although this author would still advocate its use. Following application of bone graft the joint is temporarily stabilised at a functional angle of approximately 110° using arthrodesis wires. Rigid stabilisation is required being achieved most reliably in patients of all sizes with bone plate and screw fixation. Achieving adequate screw purchase in the scapula is challenging given its limited thickness. The bone plate should be contoured to lie along the cranial part of the scapular spine, but be twisted slightly caudally (approximately 45°) to allow screw placement in the thicker bone, where the scapular spine meets the scapular body. At least four screws should be placed in the scapula, although increasing the screw numbers in this region by using a longer plate has been recommended by some surgeons. The use of two plates placed cranial and caudal to the scapular spine can also be considered to optimise the bone implant interface and construct stability. The use of locking plate technology may help overcome some of the fixation challenges in this region as well as reducing the requirement for the precise plate contouring required with non-locking plate systems. Distally the bone plate is contoured to lie on the cranio-lateral aspect of the humerus. Achieving compression of the articular surfaces is important and can be achieved by placement of plate screws as compression screws crossing the arthrodesis site or alternatively lag screws can be placed across the arthrodesis site following temporary stabilisation with arthrodesis wires but prior to plate application. Arthrodesis wires can be removed or simply cut and left in situ. Following plate application and prior to closure the greater tubercle and acromion are re-attached if they have been osteotomised.

Activity should be heavily restricted for the first 6 weeks at which point radiography is performed. If progression of the arthrodesis is documented the activity levels can be gradually increased. The client should be advised of possible postoperative complications such as infection, implant failure or delayed/non-union.

**Stifle arthrodesis** is uncommonly performed, although can be indicated for chronic stifle pain where conservative treatment has failed and a more straightforward conventional procedure is unlikely to be successful. Arthrodesis can be performed for any chronically painful condition affecting the stifle apart from neoplasia. Septic arthritis is not a contra-indication, although owners should be warned that the risk of postoperative infection maybe increased. Decision making in these cases can be challenging and extensive pre-operative owner counselling is necessary. The anticipated improvement in function and quality of life must be balanced against potential complications, morbidity and costs. Stifle arthrodesis will have a significant effect on gait, although most animals can regain acceptable limb function and owner satisfaction is usually good, providing clients are counselled to have realistic expectations of what surgery will achieve. Generally animals can stand normally, but tend to circumduct the limb when ambulating.

Initially patients may have some difficulty when lying down or when rising from a sit or from rest. However, most animals will adapt well, and sitting and lying does not appear to present problems in the long term. Functional outcome may be better in smaller dogs compared to larger breeds.

Principles of arthrodesis include removal of all articular cartilage, stabilisation of the joint at a functional standing angle, rigid fixation, and application of a bone graft. The procedure is easier to perform with the dog in dorsal recumbency with the limb extended caudally; a tilting surgical table can be helpful.

A craniolateral approach is made incorporating a tibial tuberosity osteotomy. Both cruciate ligaments and the menisci are removed. Preservation of the collateral ligaments is not essential but can aid maintenance of limb alignment during surgery. The stifle is held at a standing angle, around 120 degrees for a cat and 135 degrees for a dog. Stabilising the joint at the correct angle is critical; the most common error is positioning the joint in excessive extension. A goniometer or pre-bent Steinmann pin is useful to aid positioning. Temporary K-wires are driven across the joint to maintain alignment. Using an oscillating saw, parallel osteotomies are then made to remove the distal aspect of the femoral condyles and the tibial plateau, providing flat surfaces of cancellous bone. Once the osteotomies have been started, it is necessary to withdraw the K-wires to complete the cuts. The femur and tibia are then reduced and the K-wires replaced to stabilise the bones. A plate is then contoured to the cranial aspect of the limb; this should be as long as possible to reduce the stress riser effect at the end of the plate. Screws are then inserted to attach the plate to the bone and provide compression of the arthrodesis. In some patients lag screws can be placed independent from the plate to achieve interfragmentary compression before bone plate application. In larger dogs, a second implant can be added medially if desired. A bone graft should be packed around the arthrodesis site. The tibial tuberosity is then re-attached using pins and a tension band wire prior to routine closure.

Postoperative care consists of judicious use of analgesics and assisted walking for the first few days. Scuffing of the nails is commonly observed but this usually resolves over the course of a few weeks. Once the patient can walk unassisted controlled walks are gradually increased over a 2-3 month period. Follow up radiographs are obtained to document healing of the arthrodesis prior to resolution of unrestricted activity.

Information on postoperative complications is scarce. These can include poor limb function, infection, implant failure and femoral or tibial fracture. With meticulous surgical technique, in particular arthrodesis of the joint at the correct angle, complications appear to be uncommon.

**Elbow arthrodesis** is rarely performed. The most common indication would be end stage osteoarthritis; others would include intractable joint instability, luxation (chronic or congenital), non-repairable articular fractures or where severe complications associated with articular fracture repair have developed. **Given the large range of elbow motion required for normal ambulation, arthrodesis results in marked impairment of limb function; this should be borne in mind and communicated clearly to the client pre-operatively.** The standing elbow angle of the contralateral thoracic limb should serve as a guide for determining the angle of arthrodesis; this is generally 110°. Arthrodesis is achieved using bone plate and screw fixation; the bone plate is generally placed on the caudal aspect, although more recently a procedure specific plate allows for medial plate application. The limb is prepared for surgery circumferentially from the dorsal midline to the carpus. The animal is positioned in lateral recumbency with the affected limb uppermost. A caudal approach to the elbow is used with olecranon osteotomy is used to expose the joint. Removal of the articular cartilage is best achieved using a high-speed bur in order to preserve the normal contour of the joint. Bone graft is placed at the site of arthrodesis. Additional removal of bone from the remaining olecranon is performed to create a flat surface for plate application. Care should be taken; the radial nerve lies beneath the lateral head of the triceps near the distal third of the humerus, whilst the ulnar nerve courses over the medial aspect of the elbow, caudal to the medial epicondyle.

The plate should be long enough to allow at least four screws to be placed proximally and distally to the elbow. When using the caudally applied bone plate, interfragmentary compression is ideally achieved by a lag screw is placed through the plate and across the lateral portion of the humeral condyle into the radial head. A second lag screw is placed through the plate across the ulna and into the medial portion of the humeral condyle. Screws placed through the ulna should penetrate the radius if possible to optimise bone screw purchase. The osteotomised portion of the olecranon is reattached medially using a lag screw.

Postoperative radiographs should be critically evaluated for limb alignment and implant placement. A soft-padded bandage is placed around the forelimb postoperatively to control bleeding and limit postoperative swelling. The animal should be confined, with activity limited to leash walks, until bone healing is complete.

Like stifle arthrodesis complications of elbow arthrodesis are poorly described. They can include infection, delayed union or non-union, implant migration, implant irritation to soft tissues, fracture of the bone at either end of the plate, and increased degenerative changes in the distal joints of the limb, which are forced to compensate for the loss of the elbow's range of motion.