Stifle arthrodesis in two cats

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Case Report

Two Domestic Shorthaired cats were admitted after sustaining multiligamentous injuries of the stifle joint. In one cat, prosthetic ligamentous reconstruction was unsuccessful at maintaining normal stifle stability. Both cats were treated with stifle arthrodesis using internal fixation with a plate and screws without external coaptation. In one case, arthrodesis was achieved using a 2.7 mm 16-hole dynamic compression plate placed medially. In the second case, a 2.7 mm 14-hole dynamic compression plate was placed cranially. No major complications were noted, and both cats were able to return to good levels of activity in the medium term.

Case reports

Case 1

An eight-year-old, female-neutered, domestic Shorthaired cat was presented as an emergency, having sustained acute trauma of unknown origin. Clinical examination revealed 10/10 lameness of the left pelvic limb as a result of complete stifle dislocation. General examination was otherwise unremarkable, and no other injuries were identified. The medial and lateral collateral ligaments and cranial and caudal cruciate ligaments were considered incompetent based on physical examination.

Routine general anaesthesia was induced and maintained (►See Appendix at end). Preoperative mediolateral and craniocaudal radiographs were taken of both stifles. Radiography confirmed complete dislocation of the left stifle (►Fig. 1). The contralateral limb was positioned in what was deemed to be the normal standing angle for this cat for the mediolateral radiograph. This allowed the plate to be appropriately contoured preoperatively by using the contralateral limb as a template. The left pelvic limb was prepared aseptically and the cat was positioned in dorsal recumbency for surgery.

An extended craniomedial approach was made to the left stifle joint. The medial para-patellar skin incision extended from the distal one-third of the craniomedial tibia to a point one-third the length of the distal femur. A medial para-patellar stifle arthroscopy was made, and the patella was luxated laterally. The capsular incision was advanced proximally along the cranial edge of the cranial body of the sartorius muscle to include transection of the aponeurotic insertions of the sartorius, gracilis, and...
semitendinosus muscles. The medial cortices of the femur and tibia were exposed by a combination of digital and scissor blunt dissection. The joint could be widely exposed from its medial aspect due to the medial collateral ligament rupture. This allowed excellent exposure of all femoral and tibial articular cartilage.

The ruptured ends of the cruciate ligaments and both menisci were removed using sharp dissection. The articular surfaces of the femur and tibia, as well as the femoropatellar articular surfaces were debrided using a high-speed pneumatic bur until subchondral bone was exposed. The defects were packed with cortico-cancellous bone harvested from the cranial region of the left ilium (7). The pre-contoured 2.7 mm, 16-hole dynamic compression plate was used as a template for the appropriate angle of fixation at 120° of flexion. The femur and tibia were then stabilised in this position by the application of two crossed 2.0 mm Kirschner-wires. A 2.7 mm positional screw was placed from the patella into the distal femur. Precise contouring of the plate to the medial surface of the femur and tibia was then performed using a plate bender. Definitive stabilisation was provided using this plate applied medially with fixation using 2.7 mm screws apart from the most proximal and distal extents of the plate which were fixed using 2.4 mm screws). The medial musculofascial incision, subcutaneous tissues and skin were all closed routinely in three layers. Postoperative radiographs revealed satisfactory alignment, apposition, and implant position, with a stifle flexion angle of 119° (Fig. 2).

No external coaptation was applied. The cat was hospitalised for three days after surgery. At the time of discharge the cat was occasionally placing the foot but was primarily not bearing weight on the repaired limb. Instructions were given to the owners to confine the cat to a cage for six weeks and to administer meloxicam for the first seven days.

Fig. 1 Mediolateral radiograph of the left stifle on presentation of Case 1. Marked cranial displacement of the tibia in relation to the femur is evident.

Fig. 2 A) Mediolateral radiograph of the left stifle (Case 1) immediately postoperatively. A 2.7 mm 16-hole dynamic compression plate has been applied medially. A 2.7 mm positional screw was placed from the patella into the distal femur. Two 2.0 mm Kirschner wires were placed for initial stabilisation. The flexion angle of the stifle is 120°. B) Caudocranial radiograph of the left stifle (Case 1) taken immediately postoperative. Good alignment and apposition of the femur and tibia has been achieved. Successful contouring of the plate to the medial aspect of the bone has been achieved.
After two weeks the cat was re-examined. The wound had healed without complication and the skin sutures were removed. At this stage the cat was bearing weight on the limb with every step, but with the entire limb externally rotated. The digits were consistently scuffing the floor, and the ipsilateral hock joint tended towards hyperflexion. There was no pain response during examination of the repaired limb.

At six weeks postoperatively the cat was walking on the repaired limb with pronounced circumduction and was standing with a more obvious tendency towards a plantigrade stance. Radiography revealed that the plate and screws were in the correct position with no evidence of implant loosening. At this stage there was advanced osseous union. A recommendation was made for weekly physiotherapy and hydrotherapy, but the owner declined for logistical reasons. A further six weeks of room rest was advised, with resumption of normal activity thereafter.

Six months postoperatively the cat was able to perform normal activities including climbing and jumping. The cat was walking well on the limb with the arthrodesis, albeit with an altered gait. There was obvious circumduction of the limb when walking and an improvement in the ipsilateral hock hyperflexion. Radiographs (Fig. 3) were taken which showed complete osseous union at the arthrodesis and no evidence of implant-related complications.

**Case 2**

An eight-year-old male Domestic Short-haired cat weighing 7.7 kg was presented with a sudden onset 10/10 lameness of the left pelvic limb. Trauma had not been witnessed, but was assumed because the cat was found outdoors at the onset of the severe lameness. Physical examination revealed the cat was obese. Orthopaedic and radiological examinations revealed similar findings to those of Case 1.

An attempt was made to reconstruct the multiple ligamentous injuries using extracapsular suture prostheses. No transarticular coaptation or external skeletal fixation was applied postoperatively. The cat was represented two weeks postoperatively and...
there was a severe weight-bearing lameness affecting the injured left pelvic limb. Despite instructions being given to the owners about strict cage confinement, the cat had been allowed to exercise freely in a single room. Re-examination revealed that the stifle was unstable in multiple planes (especially when a valgus force was applied), implying surgical failure. Revision surgery was planned using stifle arthrodesis.

The anaesthetic protocol, surgical preparation; and technique for stifle debridement were the same as those employed for Case 1. The surgical approach differed from Case 1. A craniolateral parapatellar approach to the stifle was used as previously described (8). This allowed the stifle joint to be approached from both medially and laterally. An estimation of the flexion angle had been made from the contralateral limb and two crossed 2 mm Kirschner wires were placed to stabilise the stifle prior to plate and screw application. Contouring of the plate was performed intraoperatively using roller type plate bending pliers. Definitive stabilisation was provided using a 14-hole, 2.7 mm dynamic compression plate, cranial to the stifle joint with 2.7 mm screws placed throughout. Seven screws were placed in the femur and seven in the tibia. No attempt was made to relocate the patella, which was luxated laterally. The remnants of the ligamentous attachments of the patella were used to suture the patella to the adjacent vastus lateralis muscle with metric 2 polydioxanone sutures in a simple interrupted pattern to ensure that the patella would not contact the plate. The skin incision was closed with a staple. Postoperative radiographs revealed satisfactory alignment, apposition, and implant position with a stifle flexion angle of 120° (Fig. 4). The cat was hospitalised for three days after surgery and meloxicam was dispensed for use during the first seven postoperative days. Postoperative instructions to the owners were the same as those given in Case 1.

Two weeks postoperatively the cat was re-presented for examination at which time it was placing the foot consistently with every step. There was a mild weight bearing lameness, with circumduction of the limb and mild hyperflexion of the ipsilateral hock joint. The surgical incision had healed without complication and the staples were removed. There was no pain response during manipulation of the repaired limb. Similar function was noted six weeks postoperatively. The weight bearing lameness was considered slight at this time. Radiography at this stage revealed complete osseous union between the femur and the tibia with no change in alignment or implant-related complications.

One year later, the cat was re-presented by the owners because the Kirschner wire that had been used for initial stabilisation had migrated through the skin. This was removed under deep sedation following radiography, which had revealed complete bony union of the arthrodesis. The plate and screws were radiographically unchanged, with no evidence of implant loosening being identified.

A further re-examination was performed 20 months after surgery. The cat was fully weight bearing on the operated limb (Video – Available online at www.vcot-online.com). The owner reported that the cat could jump and run at home, although there was mild circumduction of the limb when walking at faster gaits. Radiography revealed complete arthrodesis with no evidence of any complications (Fig. 5).

Discussion

Multiligamentous injuries affecting the feline stifle joint are relatively uncommon, but they do occur more frequently in cats than in dogs (2, 9, 10). Injuries most commonly occur secondary to major traumatic events, including road traffic and high-rise accidents (11). Disruption of the cranial and caudal cruciate ligaments and the medial and lateral collateral ligaments are the most common combination of multiligamentous injuries. These injuries can lead to complete stifle luxation (11). The joint capsule and menisci are also commonly damaged concurrently (9, 12). The individual ligamentous injuries can usually be diagnosed by careful clinical examination (13). Marked cranial displacement of the tibia in relation to the femur will occur with rupture of the cruciate ligaments. Significant medio-lateral instability is expected when the collateral ligaments have been damaged (9, 12).

Current recommendations for treating multiligamentous injuries of the stifle joint include ligament reconstruction or replacement (with or without temporary transarticular pin fixation), transarticular external skeletal fixation, and stifle arthrodesis (4, 9, 11). In some cases, substantial trauma to the ligaments as well as menisci and joint capsule may preclude primary reconstruction. Careful examination of the menisci before performing any necessary ligament reconstruction is mandatory (13). In Case 2, reconstruction of the cruciate and collateral ligaments was unsuccessful, with marked instability being recognised two weeks postoperatively. Based on the positive results reported previously as well as our personal experience of the successful surgical reconstruction of
multiligamentous injuries of the feline stifle, a favourable prognosis was expected (9, 11). Recommendations have been made to protect the primary repair with some form of external coaptation during the first two to three weeks of recovery (4). In retrospect, it is likely that use of transarticular external skeletal fixation would have avoided the surgical failure seen in this case. However, it is also important to recognize that a similar lack of compliance in the early postoperative period might have resulted in fracture of the femur or tibia through one of the fixator pins had an external skeletal fixator been used (12).

In Case 1, stifle arthrodesis was chosen as the initial treatment modality as there was complete rupture of the cranial and caudal cruciate ligaments, and the lateral and medial collateral ligaments as well as crushing injuries of the medial and lateral meniscus. In our opinion, long-term stability to the stifle was considered to be unlikely after medial and lateral meniscectomy and multiligamentous replacement, even if temporary transarticular external fixation was employed.

Other authors have previously suggested that the prognosis for a full return to function following stifle arthrodesis is guarded, and it has also been anecdotally reported that all cats should be expected to have an altered gait in the long-term. These abnormalities have been characterised as circumduction of the affected limb, with difficulty expected when the cat attempts to jump or climb (4). However there are not any previously published reports describing the short and long-term follow-up for cats that have undergone stifle arthrodesis. In the two cats we report here with medium-term follow-up, a successful return to normal levels of exercise including normal outdoor exercise was observed.

An extended cranio-lateral incision to the stifle joint has been recommended to allow the joint to be approached both laterally and medially. This was the approach used in Case 2. Although a tibial tuberosity osteotomy has been recommended when making this approach in order to optimise access for cartilage debridement, we found that this procedure was not necessary (4). The disadvantage of leaving the tibial tuberosity intact is that it is more difficult to contour the bone plate to the cranial surface of the tibia.

Cartilage debridement is necessary for any arthrodesis. Previous reports for stifle arthrodesis have described osteotomy of the tibial plateau and distal femur proximal to the intercondylar notch (1, 4, 5). In humans this technique of knee arthrodesis has been shown to result in primary bone union at the arthrodesis (14). Although osteotomy effectively removes all articular cartilage, it does create a limb-shortening effect, which can be compensated by the animal by the addition of 10–20° to the standing angle of the contralateral stifle joint. In both of the described cases, articular cartilage was removed using a high-speed burr. In Case 2, the primary advantage of burring the cartilage was that it allowed the cranial plate to be placed without an angular constraint being imposed by the geometry of the femoro-tibial osteotomies. In contrast, if femoral and tibial osteotomies are employed, it is difficult to alter the tibial flexion angle after the initial osteotomies have been created without producing further limb shortening (2).

In these two cats, the insertion of bone graft was considered important to fill the defects caused by the lack of femorotibial congruity after cartilage debridement (4, 5). In contrast, techniques using osteotomy of the tibia and femur create a large area of apposed cancellous bone and additional bone grafting may not be necessary (2, 14).

There is little guidance in the current literature regarding optimal arthrodesis angles in the cat, with recommended angles ranging from 110° to 125° (2, 4). In both of the cats in this report, an angle approximating 120° was achieved, and this was based on estimation of the expected standing angle of the contralateral limb. In Case 1, there were early concerns that the selected arthrodesis angle was too large, as the cat was mainly non-weight-bearing at faster gaits with marked circumduction of the limb, and at slower gaits there was scuffing of the toes. It is possible that the flexion angle chosen in this cat was excessive, and that this individual was only able to compensate poorly for this increased flexion angle by altering the flexion angles of the ipsilateral hock joint and contralateral pelvic limb joints. In Case 2, the angle of 120° seemed to result in good early weight-bearing and function of the limb. This emphasises the fact that an individual cat should be carefully assessed preoperatively to evaluate the normal standing angle of the contralateral stifle joint. It is important to recognize that this angle might be significantly altered in the presence of a contralateral injury; however, photographic or video evidence of the animal’s normal gait prior to injury might be available from the owners, and this evidence may be especially useful for preoperative planning. In retrospect, the result in Case 1 might have been improved by choosing a flexion angle closer to 110°. By objectively assessing the cats after surgery, it could be seen that the cat in Case 1 was unable to compensate by increasing contralateral stifle extension. This means that the ipsilateral hock joint must be hyperflexed, or a greater degree of circumduction of the operated limb must occur, or both. In Case 2, a greater degree of extension at a standing angle in the contralateral stifle may be the reason why this cat had a more ‘normal’ gait immediately postoperatively.

Although increasing stifle flexion angle may be desirable in some cats, one potential problematic consequence is increased stress on the plate, which may predispose to implant failure. The increased bending moment might also predispose to fracture of the tibia or femur at the stress risers centred on the extremities of the plate. Some texts suggest removal of the plate and screws six to nine months postoperatively to reduce the risk of tibial or femoral fracture (2). Another precaution recommended to reduce the possibility of iatrogenic fracture is reduction of the implant lever arm by choosing a long plate that distributes the bending forces across a greater number of screws (15). It is also important that the plate reaches the metaphyseal areas of the bones and does not end in narrow diaphyseal regions (4). In Case 2, the plate used was shorter than this optimum length, terminating at the level of the femoral and tibial diaphyses; however, no adverse effects on outcome were encountered as a result of this divergence from recommended technique. The application of a medial plate as used for Case 1 has not been reported previously. The feline femur is wider in the
frontal plane than the sagittal plane so a potential advantage of medial plating is an increased surface area of screw purchase. The primary bending moment acts in the craniocaudal plane and in a cranial plate this terminates on the cranial surface of the femur and tibia. The primary bending moment is therefore acting at the junction of the plate and bone, levering the bone against the terminal end of the plate. Conversely, when a medial plate is used, the craniocaudal bending moment is acting on the terminal screw, which has a large surface area of bone contact and the stress is more evenly distributed across the bone itself (16). Another potential benefit of the medially applied plate is that the patella can be reattached to the femur within the trochlear groove. Although the primary function of the quadriceps muscle in effecting stifle extension is rendered redundant by stifle arthrodesis, this feature might promote improved postoperative hip flexion. In addition, based on our experience, contouring of the plate was no more challenging for medial application than it was for cranial application.

In summary, we have reported two cases of feline stifle arthrodesis following traumatic multiligamentous injury. In both cases, follow-up examinations performed at six months and 20 months revealed good function, with the owners reporting that the cats could jump and run at home, albeit with a slightly circumducting gait on the operated limb. No major complications occurred in either case. The outcome in both these cats suggests that stifle arthrodesis is a viable option in cats with end-stage stifle disease. Our experience suggests that medial plating is a good alternative to cranial plating, although a comparison of a larger case series would be required to establish optimal surgical technique. Further work is also required to determine the most appropriate stifle arthrodesis angle in cats.

Appendix

Pre-anaesthetic medication was with acepromazine (0.02 mg/kg) and methadone hydrochloride (0.2 mg/kg) intramuscularly, induced with propofol (6 mg/kg) and maintained with isoflurane and 100% oxygen through auffed endotracheal tube. Intraoperative analgesia was provided by injections of methadone hydrochloride intravenously every four hours, this was continued postoperatively for 12 hours intra- muscularly. Cerufoxime sodium (22 mg/kg) was administered intra-operatively.

Conflict of interest

None declared.

References