Repair of a transverse ilial fracture in a cat using an intramedullary pin

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Ilial, intramedullary, cat, fracture, Steinmann pin

Summary
Objective: This case report describes the novel use of an intramedullary pin in an eight-month-old cat to repair malunion of a right transverse ilial fracture that was causing pelvic canal diameter narrowing and constipation.

Method: A routine, right femoral head and neck ostectomy was performed due to the presence of a femoral head fracture with apparent femoral neck necrosis. Significant cal- lus formation around the ilial fracture was removed in order to achieve satisfactory fracture reduction. A 2 mm Steinmann pin was passed in a retrograde fashion from the acetabular fracture towards the ischial tuberosity, and following removal of the trochar tip and reduction of the fracture, was driven normograde to end in the cranial ilial wing. The pin was bent at the ischium following cutting in an attempt to prevent cranial migration.

Results: Radiographic examination showed good fracture alignment and increased pelvic diameter by 31% The cat regained normal limb function and the constipation resolved.

Clinical significance: A transilial pin was utilised successfully in a cat to realign and stabilise a simple transverse ilial fracture following femoral head and neck ostectomy. This technique has the potential to be useful for stabilisation of feline caudal ilial body fractures, but should not be used where there is articular surface involvement unless the coxofemoral joint is not preserved. Further studies are required to assess this technique.

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Introduction
Pelvic fractures are common following traumatic injury in the cat and can comprise approximately 20 to 22% of all presenting feline fractures (1). Fractures of the ilium comprise 50% of these cases and are usually oblique because of the slope of the ilium and its relationship to the sacrum (1). The fracture often runs from cranioventral to caudodorsal, and the caudal ilial section is usually displaced medially and cranially, contributing to nar- rowing of the pelvic canal (2).

Lateral plating of simple, oblique ilial fractures is the most commonly used method of repair, although dorsal plating has recently been described (3). Other tech- niques include lag screws, screw and wire or pin and wire combinations (2, 4).

This report describes a transverse ventrodorsal fracture of the ilium and acetabu- lum, and a right capital physeal fracture in a cat as the result of a suspected road traffic accident. Conservative treatment resulted in malunion which caused marked pelvic canal narrowing and constipation. Successful surgical reduction was achieved using a single intramedullary pin placed from the ischium to the cranial ilial wing. This tech- nique is simple, rapid and achieves ade-

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equate fracture reduction, stability and restoration of pelvic diameter. Additionally, it may be of benefit where there is excess cal- lus formation because it eliminates the requirement for plate contouring or callus removal.

Case report
An eight-month-old male neutered Domes- tic Shorthaired cat was referred for as- sessment of an ilial fracture, constipation and dyschezia one month after a suspected road traffic accident. Previous manage- ment by the referring veterinarian had in- cluded cage rest, analgesia and medication with liquid paraffin. Previous thoracic radiographs were within normal limits.

Upon physical examination at the refer- ral hospital (Small Animal Hospital, Uni- versity of Bristol), the cat was found to be non-weight-bearing lame on the right hindlimb with occasional toe touching. Moderate muscle wasting was evident in this limb, and crepitus and signs of pain were elicited upon palpation of the right hip and pelvis. Neurological assessment was within normal limits. Impacted faeces were palpable in the colon, but the re- mainder of the physical examination was unremarkable.

Ventral- dor- sal and lateral pelvic radio- graphs showed a simple complete transverse ventrodorsal fracture of the right ilium and cranial acetabulum (Fig. 1). The caudal fragment was displaced craniomedially, result- ing in narrowing of the pelvic canal. The fracture margins were not sharply defined, which was consistent with a fracture of more than seven days duration. A right capital physeal fracture with apparent femoral neck necrosis was evident; the femoral neck was displaced medially, cranially and ventrally with respect to the acetabulum. A right

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evident throughout the colon and rectum, but the colonic diameter was less than 1.5 times the length of seventh lumbar vertebrae and thus was not consistent with a megacolon (5). The remainder of the proximal pelvic limbs, as well as the caudal lumbar, sacral and coccygeal spine were all unremarkable.

Surgery

Premedication consisting of methadone (0.1 mg/kg) and dexmedetomidine (10 μg/kg) was administered intramuscularly before anaesthesia was induced with intravenous alfaxalone (5 mg/kg) given slowly to effect. Intrathecal bupivacaine (0.3 mg/kg) and morphine (0.04 mg/kg) were administered and a purse string suture was placed in the anus. Clavulanic acid potentiated amoxicillin was given intravenously (20 mg/kg) thirty minutes before commencing surgery.

The cat was positioned in left lateral recumbency and following routine skin preparation, a skin incision was made over the right ischiatic tuberosity to allow it to be grasped with Kern bone-holding forceps. A standard craniodorsal approach to the right coxofemoral joint was performed, including a greater trochanteric osteotomy as previously described (6). A routine femoral head and neck excision was performed with an osteotomy extending from the lateral aspect of the intertrochanteric notch to just proximal to the lesser trochanter (6). The femoral head was removed from the acetabulum following transection of the teres ligament. As expected, there was a significant amount of fibrous and mineralised callus which needed to be broken down in order to achieve adequate reduction of the fracture, and the desired increase in pelvic canal diameter. A 2 mm Steinmann pin was passed in a retrograde fashion from the fracture at the level of the acetabulum towards the ischial tuberosity, and then following removal of the trochar tip and reduction of the fracture, it was driven normograde to end in the cranial ilial wing. In order to maximise pin stability and increase pin-bone friction, the width of the pin selected was at least 80% of the diameter of the narrowest portion of the medullary canal and the pin exited at the most caudo-dorsal point of the ischium. The pin was bent at the ischium following cutting in an attempt to prevent cranial migration. The greater trochanter was reduced and stabilised routinely with two 1.1 mm Kirschner wires and a 1.1 mm tension band wire. The muscles were sutured closed in a routine layered fashion with 3.5 metric polydioxanone in a simple interrupted pattern. The subcutaneous and skin layers were closed routinely.

Immediate postoperative radiographs, which show an improved fracture apposition and increased pelvic diameter, can be seen in Figure 2. Cage confinement for six weeks was recommended and passive range-of-motion exercises for both hindlimbs was to be done four times daily for the entire six-week duration. Radiographs taken 15 weeks postoperatively are shown in Figure 2. In order to quantify the increase in pelvic diameter, the pelvic canal diameter ratio was calculated from ventrodorsal radiographs as previously described (7). The preoperative pelvic canal diameter ratio was 0.76; the immediate post oper-

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Fig. 1 Preoperative ventrodorsal pelvic radiograph (left) and preoperative right lateral pelvic radiograph (right).

Fig. 2 (Left) Immediate post operative ventrodorsal pelvic radiograph; (Centre) 15 weeks postoperative ventrodorsal pelvic radiograph (Courtesy of Silva House Veterinary Group); (Right) Calculation of pelvic canal diameter ratio on ventrodorsal radiographs is determined by CD/AB. AB = distance between caudal aspect of sacral joint surfaces; CD = distance between medial aspect of acetabulae (modified from Averill [7]).

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a Synastone: Martindale, Essex, UK
b Dexdomitor: Pfizer, Kent, UK
c Alfaxan: Vetoquinol, Buckingham, UK
d Morphine sulphate: Martindale, Essex, UK
e Augmentin: GlaxoSmithKline, Middlesex, UK
f PDS®: Ethicon, Edinburgh, UK
ative ratio was 1.1, and 15 weeks postoperatively the ratio was 1.0. Compared to the original radiograph, this represents a pelvic canal diameter ratio increase of 31% immediately postoperatively, and 24% after 15 weeks.

Postoperative recovery

Postoperative recovery was uneventful and the cat was ambulatory the following day. Postoperative medication consisted of morphine (0.2 mg/kg IV q4h) for the first 24 hours, buprenorphine\(^a\) (0.02 mg/kg IV q8h) for the following three days, meloxicam\(^b\) (0.05 mg/kg q24h) orally for two weeks, liquid paraffin (5 ml PO TID), and clavulanic acid potentiated amoxicillin\(^c\) (17.2 mg/kg orally q12h) for three days. The cat was discharged four days following surgery.

The follow-up examination performed at 15 weeks revealed excellent limb function and ambulation, and a good range-of-motion for the right hip. There were not any signs of pain and the hindquarter muscle mass was symmetrical and normal. The cat was defaecating normally.

Discussion

The rigid box-like structure of the pelvis ensures that any fractures are usually multiple and the force of the traumatic insult means that simultaneous multiple injuries are common, necessitating a thorough major body systems assessment and stabilisation on presentation (1, 8).

Both surgical and conservative management have been described for pelvic fractures in the cat. Surgical intervention is recommended if there is narrowing of the pelvic canal, signs of extreme pain, neurological deficits, acetabular involvement and inability to walk after three days of conservative management (1, 9). Conservative management in this cat had resulted in persistent lameness that would likely have solved following femoral head and neck excision, but the issue of constipation secondary to pelvic canal narrowing was considered as indication for surgery to address the fracture malunion and reduce the probability of development of megacolon.

Intramedullary pin selection in this case was based on 80 to 90% of the diameter of the ilial medullary cavity, which was assessed on preoperative ventrodorsal radiographs at the level just cranial to the acetabulum on the left (unfractured) side. This technique was considered suitable in this case because of the excellent resistance to subjected forces (namely bending) and rapid speed of application. Rotation, compression and shear forces in this fracture are likely to be minimal. The theoretical risk of cranial migration of the intramedullary pin was minimised by bending the pin at the ischial aspect. After 15 weeks, there had not been any pin migration detected and fracture callus was minimal.

In some circumstances, the use of an intramedullary pin may have advantages over plate and screw fixation. The requirement for accurate plate contouring was a particular concern in this cat because of the callus formation and acetabular involvement. In addition, plate application in this case would have required caudal dissection beyond the region of the sciatic nerve, risking damage. Compared with the dog, the cat ilium is much less concave, and as such, application of an intramedullary pin from ischium to cranial ilial wing is possible.

The cranial portion of the wing of the ilium is thin and does not have good screw-holding power. Concerns regarding screw failure associated with lateral plating of feline ilial fractures have resulted in a recent description of dorsal plating (3, 10). The authors chose not to place a dorsal plate and screws in this case because of the acetabular location of the fracture and the additional surgical time and dissection required by this technique. In this case, maintenance of accurate reduction of the transverse fracture was challenging and Kern bone holding forceps applied to the ischium assisted significantly in the attainment and maintenance of reduction during intramedullary pin placement.

Cranio medial displacement of the caudal ilial fragment can cause sciatic nerve damage in up to 11% of cats, but this was not seen in the current case (11). The sciatic nerve originates from L6-L7 and L7-S1 and runs from the ventral border of the sacrum towards the ischium along the medial side of the ilial wing. It then courses dorsally over the ischium and across the caudodorsal aspect of the hip joint before continuing distally along the limb. Iatrogenic damage could occur during reduction or during pin placement in the caudal section of the fragment (2). Given the narrow width of the ilium, there is also the potential for the pin to easily enter the pelvic canal on the medial aspect of the ilium, which may cause visceral damage (12). In order to minimise the chance of this occurring, the tip of the pin was cut off before it was driven normograde along the ilial wing and pin advancement was always performed by hand, facilitating accurate assessment and early appreciation of any resistance. By achieving accurate retrograde pin positioning initially, it was anticipated that this would facilitate precise orientation when advancing the pin in the normograde direction, particularly because the medullary cavity of the feline ilial wing is relatively straight in orientation. As the ilial cortex thins crani ally, resistance to pin-exit decreases. This risk can be reduced by removal of the trochar tip, but remains possible (as occurred in this case). Careful pin advancement and preoperative pin measurement is therefore recommended. Intraoperative risks might also be minimised by the use of intraoperative fluoroscopy, although it was not used in this case.

The normal pelvic canal width ratio in the dog is 1.1 and this was successfully achieved following fracture reduction and stabilisation in this case (7). To date, no normal ratio has been described for the cat.

This procedure may be more challenging in a cat that does not require a femoral head and neck osteotomy, as the straight pin may pass close to or risk penetration of the acetabular surface. The presence of a chronic capital physeal fracture in this cat indicated that accurate reduction of the acetabular surface was not critical to this repair. The authors are of the opinion that if a caudal ilial body fracture results in exposure of medullary canal dorsal to the level of the acetabulum, then a similar techn-
nique may be considered in the presence of a normal coxofemoral joint. However, a study of a series of cross-sectional images of the entire feline pelvis would be necessary to determine the feasibility of this technique. Animals with acetabular fractures, or fractures considered susceptible to significant rotational forces, would not be suitable candidates for this technique because additional stability and more accurate articular surface alignment would be required.

Conclusion

A transilial pin was utilised successfully in a cat to realign and stabilise a simple oblique ilial fracture following femoral head and neck ostectomy. This technique has the potential to be useful for stabilisation of feline caudal ilial body fractures, but it should not be used where there is articular surface involvement, unless the coxofemoral joint is not preserved. Further studies are required to assess this technique.

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