Treatment of bicondylar femoral fractures complicated by concurrent ligament or tendon injuries in four dogs

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Keywords

Bicondylar, fracture, femur, soft tissue, stifle

Summary

Objective: Retrospective case series describing the surgical treatment and outcome in dogs with bicondylar femoral fractures complicated by ligament or tendon injuries.

Methods: Medical records were reviewed for three immature and one mature dog with traumatic bicondylar fractures of the distal femur and concurrent ligament or tendon injury treated surgically. Data retrieved included physical examination, imaging, and treatment. Long-term follow-up and return to function was assessed by owner feedback, physical examination, radiology, and force plate analysis. The immediate, four-week, and two-year postoperative outcomes were described.

Results: All four dogs were presented with injuries to either the cranial or caudal cruciate ligament. Only two dogs underwent surgical repair of the caudal cruciate ligament. Anatomical reduction and rigid internal fixation of the distal femoral fractures was performed using a combination of lag screws, Kirschner wires, and bone plates. At the long-term follow-up, all cases had good to excellent return to function, as assessed by force plate analysis and owner assessment of quality of life and satisfaction. Radiographs revealed evidence of complete fracture healing, with moderate to severe osteoarthritis of the stifle.

Clinical significance: Bicondylar femoral fractures can be associated with ligament or tendon injuries. Anatomical reduction and internal fixation of bicondylar femoral fractures is recommended and may offer a good to excellent return function, with or without repair of associated caudal cruciate ligament injuries.

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Introduction

Distal articular femoral fractures may be classified as either unicondylar or bicondylar (1, 2). These fractures occur most commonly in immature dogs, however they may also occur in adult dogs (3, 4). The majority of condylar fractures are managed surgically using a combination of Kirschner wires and lag screws (4). The repair of condylar fractures in immature dogs can be complicated by poor quality of immature bone, premature cessation of physeal growth, and extensive soft tissue trauma (4). Trauma to the major ligaments and tendons of the stifle may be associated with femoral condylar fractures; however, this combination of injuries has been rarely reported in dogs (4, 5). The purpose of this case series is to describe the surgical treatment and long-term outcome of bicondylar femoral fractures with concurrent ligament or tendon injuries of the stifle in four dogs.

Case reports

Case 1

A four-month-old, 11 kg, entire male, mixed-breed dog was presented for evaluation after falling from a moving vehicle. The dog was non-weight bearing on the left pelvic limb, with marked soft tissue swelling proximal to the left stifle. A 1 cm diameter wound was present over the left lateral mid-thigh and pain and crepitus were detected upon palpation on the left stifle. The cranial drawer and tibial compression tests could not be performed due to gross instability of the distal femur. Orthogonal radiographs of the left femur revealed a grade I open, bicondylar, Salter-Harris Type IV fracture of the distal femur, consistent with a type C3 fracture (▶Figure 1A and B) (1, 6–8).

The dog was placed under general anaesthesia and positioned in dorsal recumbency for surgery. The left stifle and the distal femur were exposed through a lateral parapatellar approach extending proximally over the distal femur. Intra-operative findings included a bicondylar Salter-Harris Type IV fracture of the distal femur, with separation of the trochlear groove from the

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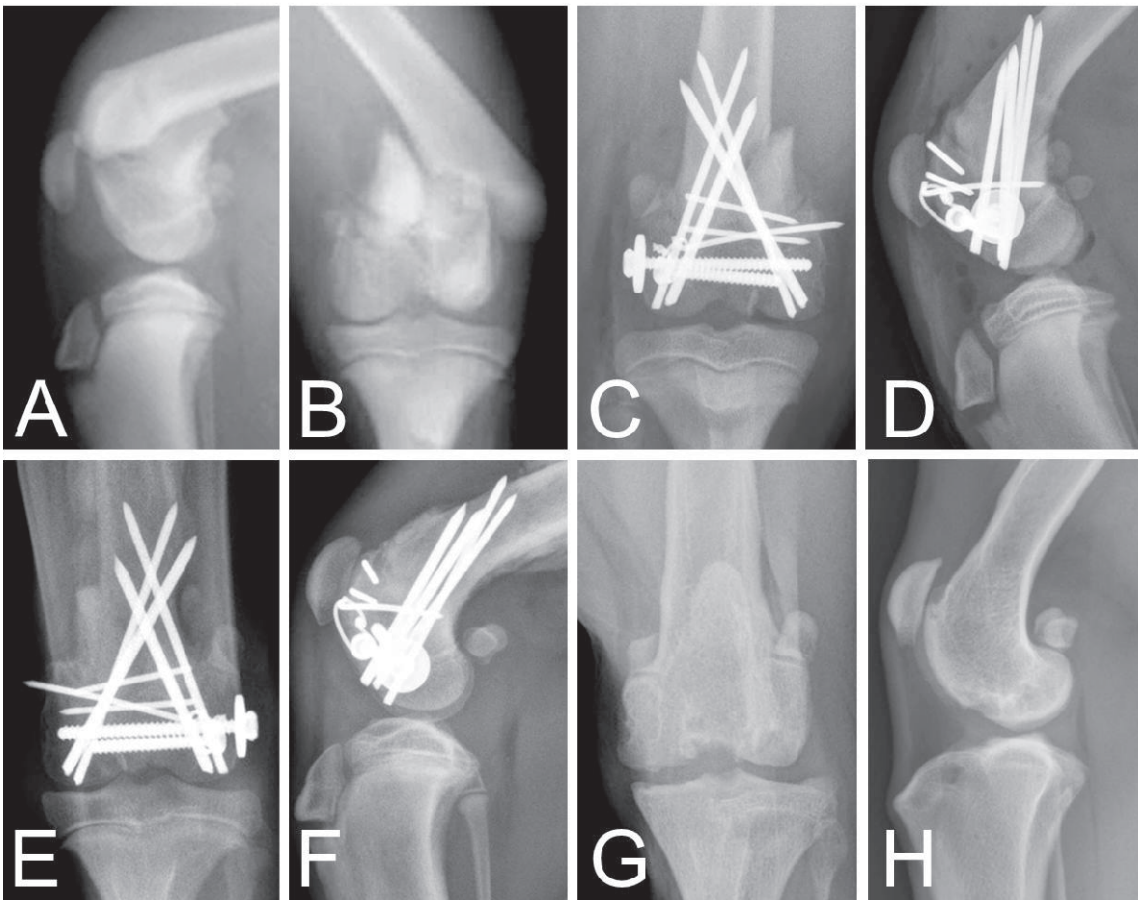

Figure 1 Preoperative radiographs of an open, complex Salter-Harris type IV fracture of the left distal femoral condyle in a four-month-old dog (case 1) **(A, B)**. The fracture was repaired with two 2.7 mm cortical bone screws, a 4 mm washer, cross-pins and cerclage wire **(C, D)**. Radiographs taken six weeks postoperatively showed a healed distal femoral fracture with good anatomical apposition and appropriate alignment of the distal femur **(E, F)**. Radiographs taken two years postoperatively showed remodelling of the distal femoral metaphyseal and epiphyseal fracture sites and osteoarthritis **(G, H)**.

major fragment, and partial avulsion of the origin of the caudal cruciate ligament (▶Figure 2A) (8). Following anatomical reduction, the intercondylar fracture was stabilized with several Kirschner wires[a] and two transcondylar screws[b] placed in a positional fashion, as application of compression would have collapsed the intercondylar notch due to comminution. Compression of the separated trochlear groove was achieved with interfragmentary wire placed between the head of a 2.7 mm transcondylar screw and a Kirschner wire positioned in the trochlear segment. The transcondylar screws were deemed to have provided sufficient fixation to the avulsed fragment; therefore, additional repair of the partial avulsion of the origin of the caudal cruciate ligament was not performed (▶Figure 1C and D, ▶Figure 2B). The incision was closed routinely. The dog was discharged with instructions to the owner for activity restriction and physical therapy, consisting of range-of-motion exercises and controlled leash walks, and the administration of meloxicam (0.1 mg/kg per orally every 24 hours) and tramadol (2 mg/kg orally every 6–8 hours, as needed for pain).

Follow-up examination performed six weeks postoperatively revealed mild left pelvic limb lameness with evidence of pain and crepitus upon palpation of the stifle, but no evidence of joint instability. Orthogonal radiographs revealed complete fracture healing with no evidence of implant failure or migration (▶Figure 1E and F). The pain and crepitus were attributed to the implants irritating the joint capsule; therefore implant removal was elected (▶Figure 2C). The dog improved and had no evidence of lameness four weeks following implant removal.

Follow-up examination two years postoperatively revealed mild left pelvic limb lameness on visual gait assessment (▶Table 1). Goniometric measurements of the stifle, circumference of the mid-thigh, length of the affected femur relative to the contralateral femur, and peak vertical force at a trot obtained at long-term recheck examination are summarized in ▶Table 2. Orthogonal radiographs demonstrated remodelling of the left distal femoral metaphyseal and epiphyseal fracture sites and moderate osteoarthritis (▶Figure 1G and H). The owners reported that the dog had regained full activity, and rated long-term outcome as excellent based on owner's assessment of quality of life and satisfaction (9).

a IMEX Veterinary Inc., Longview, TX, USA
b Synthes Vet, West Chester, PA, USA

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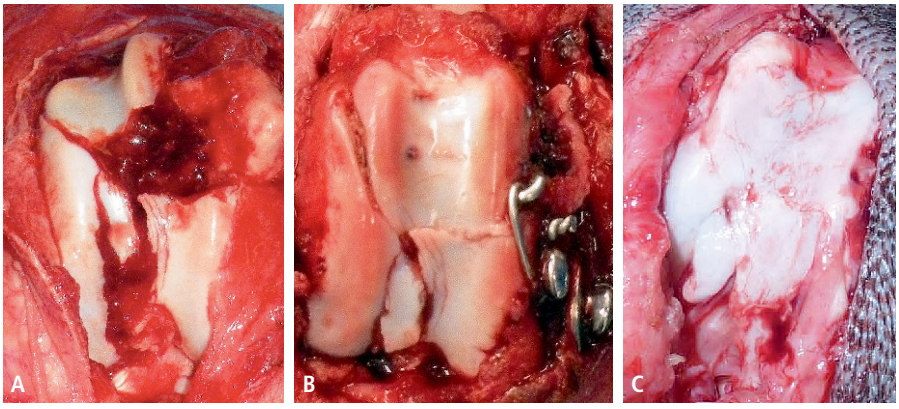

Figure 2 Intra-operative images of a sharply-marginated, open, comminuted, Salter-Harris type IV fracture of the left distal femoral condyle before repair **(A)**, after repair **(B)**, and six weeks post-operatively during implant removal **(C)**.

Case 2

A seven-month-old, entire male, 22 kg, mixed-breed dog was presented for evaluation of a chronic left distal femoral fracture and left coxofemoral luxation after being found on the side of the road. The dog was non-weight bearing on the left pelvic limb, the left greater trochanter was displaced craniodorsally, and signs of pain were elicited upon manipulation of the left coxofemoral and stifle joints. A large, firm callus was palpated on the medial aspect of the left stifle. No gross instability was detected on palpation of the stifle, however crepitus was present on stifle flexion. Orthogonal radiographs of the pelvis revealed a healing, oblique fracture of the right ilial wing, a left femoral neck fracture, and a chronic left coxofemoral luxation. Orthogonal radiographs of the left stifle revealed a chronic, unicondylar, Salter-Harris Type III fracture of the distal femur, with moderate proximolateral displacement of the condylar fragment (▶Figure 3A and B) (6).

The dog was placed under general anaesthesia and positioned for surgery in dorsal recumbency. The medial aspect of the distal femur was exposed through a medial parapatellar approach. Upon intra-operative examination of the femur, the fracture was re-classified as a bicondylar, Salter-Harris Type IV fracture, consistent with a type C3 fracture, with partial avulsion of the origin of the caudal cruciate ligament (▶Figure 4A and B) (1, 8). After excising the fibrous callus and reducing the fracture, a transcondylar 4.0 mm partially-threaded cancellous lag screw was placed to achieve adequate reduction of the medial femoral condyle. A 2.0 mm cortical screw placed in lag fashion was used to stabilize the partially avulsed origin of the caudal cruciate ligament. Several Kirschner wires were inserted in the medial and lateral condyles with cross-pinning technique (▶Figure 3C and D, ▶Figure 4C and D). The incision was closed routinely. A standard craniolateral approach was made to the left coxofemoral joint and a cementless total hip arthroplasty[c] was performed using the standard technique (10). The dog was dis-

c Universal Canine Hip System: Biomedtrix, Boonton, NJ, USA

Case	Age, gender and breed	Weight (kg)	Side	Fracture classification (Ref. 1, 6-8)	Soft tissue injury	Visual gait assessment by veterinarian
1	4 months Male Entire Mixed Breed	11	Left	C3 S-H Type IV Grade I Open	Partial avulsion CdCL	2 years Mild left pelvic limb lameness
2	7 months Male Entire Mixed Breed	22	Left	C3 S-H Type IV Closed	Partial avulsion CdCL	2.5 years Mild left pelvic limb lameness
3	6 years Male Neutered American Pit Bull	30	Right	C1 Grade III Open	Mid-body transection CdCL*	2 years Mild right pelvic limb lameness
4	3 months Male Entire Mixed Breed	15	Right	C3 S-H Type IV Closed	Avulsion CrCL	7 years Intermittent right pelvic limb lameness

Table 1 Signalment, injury characterization, and long-term outcome of dogs following bicondylar femoral fracture repair.

*Other soft tissue injuries include: Transection of the patellar ligament, tendon of origin of the long digital extensor, popliteal tendon, and lateral collateral ligament. S-H = Salter-Harris grade; CdCL = caudal cruciate ligament; CrCL = cranial cruciate ligament.

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Table 2 Goniometric measurements of the stifle, circumference of the mid-thigh, length of the femur relative to the contralateral femur, and peak vertical force at a trot obtained at long-term recheck examination (cases 1, 2 and 3).

	Case 1		Case 2		Case 3	
	Fractured	Normal	Fractured	Normal	Fractured	Normal
Extension (°)	150	160	135	150	160	162
Flexion (°)	25	25	50	40	62	60
Circumference mid-thigh (cm)	33.5	37.0	41.0	44.0	33.5	37.5
Femur length discrepancy (%)	-9.6		-5.2		0.0	
Mean PVF (%BW)	68.6	74.8	60.4	69.9	68.4	70.3
Difference between fractured and normal limbs in PVF (%)	-8.3		-13.5		-2.9	

PVF = peak vertical force. Case 4 data and measurements unavailable

charged with instructions to the owner for activity restriction and physical therapy, consisting of range-of-motion exercises and sling-assisted leash walks, and the administration of carprofen (1 mg/kg orally every 12 hours), cephalexin (22 mg/kg orally every 12 hours), and tramadol (2 mg/kg orally every 6–8 hours, as needed for pain).

Follow-up examination four weeks postoperatively revealed moderate left pelvic limb lameness and a grade 3 left medial patellar luxation (11). Orthogonal radiographs taken two months postoperatively revealed healing of the distal left femoral fracture with eccentric premature closure of the distal femoral physis, resulting in 17° of distal femoral varus (▶ Figure 3E and F). Surgical correction of the femoral varus and medial patellar luxation was performed. The stifle joint was evaluated and no

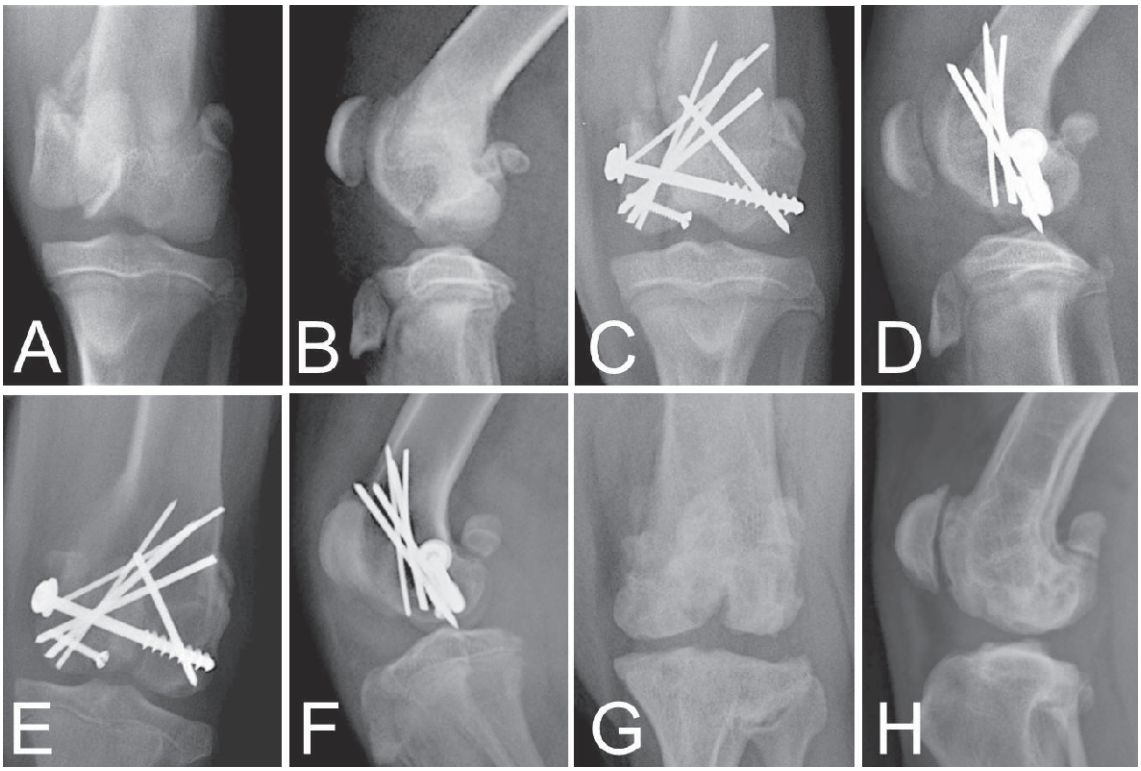

Figure 3 Preoperative radiographs of the left distal femoral fracture of a seven-month-old dog; the fracture was initially classified as a Salter-Harris type III injury (case 2). **(A, B)**. The femoral fracture was repaired with two transcondylar screws and cross pins. Postoperative radiographs of the left femur **(C, D)**. Radiographs taken two months postoperatively showed a healed distal femoral fracture and an asymmetric premature closure of the growth plate associated with distal femoral varus **(E, F)**. Radiographs taken two and a half years postoperatively showed a healed malunion fracture of the distal left femur with removal of orthopaedic implants, and moderate to severe osteoarthritis of the left stifle joint **(G, H)**.

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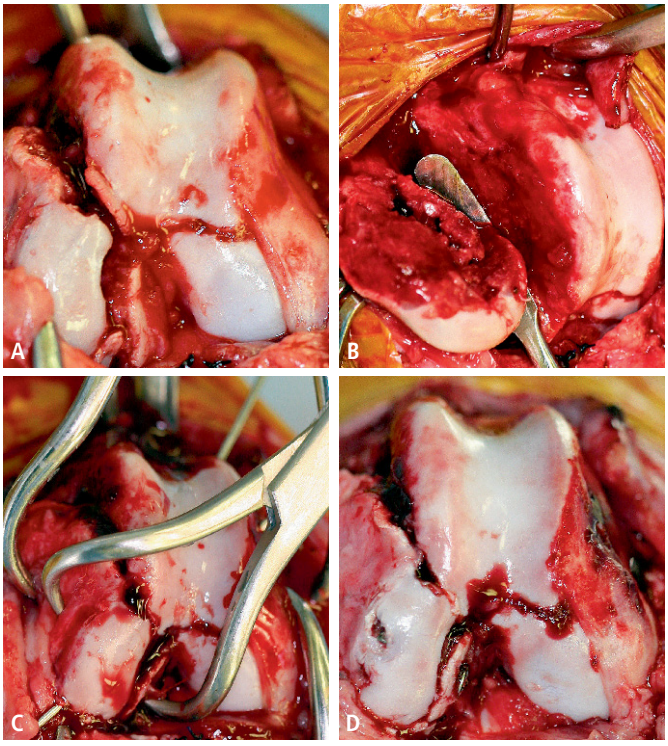

Figure 4
Intra-operative images of a Salter Harris type IV fracture in case 2 of the left distal femur before repair **(A)**, during fracture reduction **(B)**, inserting the Kirschner wire from the medial aspect **(C)**, and after completion of internal fixation of the fractures **(D)**.

evidence of pathology was noted in the cranial cruciate ligament. A transverse osteotomy was made along the transverse bisecting line in the distal metaphysis of the left femur which was then opened medially, hinging on the lateral cortex, to form a medial opening wedge of 17° and achieve appropriate femoral alignment. A seven-hole 3.5 mm locking plate[d] was applied to the lateral aspect of the femur in a bridging fashion using three cortical screws proximal and three distal to the osteotomy. Examination of the stifle under full range-of-motion revealed that patellar luxation was not present. Eight weeks postoperatively, the plate and screws were removed from the left femur due to evidence of discomfort during flexion and extension of the stifle.

Follow-up examination two and a half years postoperatively revealed mild lameness of the left hindlimb on visual gait assessment (▶Table 1). Crepitus and thickening were detected at palpation of the stifle, but no evidence of joint instability was noted. Goniometric measurements of the stifle, circumference of the mid-thigh, length of the affected femur relative to the contralateral femur, and peak vertical force at a trot obtained at long-term recheck examination are summarized in ▶Table 2. Orthogonal radiographs revealed moderate to severe osteoarthritis (▶Figure 3G and H) and no significant changes associated with the left total hip replacement. The owners reported that the dog had regained full activity but had episodes of mild left pelvic limb lameness, and rated long-term outcome as excellent based on owner's assessment of quality of life and satisfaction (9).

Case 3

A six-year-old, 30 kg, neutered male, American Pit Bull Terrier was presented for evaluation of an open right distal femoral fracture sustained after running into a metal shed. A 7 cm diameter wound on the right pelvic limb had been debrided, lavaged, and closed by the referring veterinarian prior to transfer. Physical examination was limited due to the fractious nature of the dog. Orthogonal radiographs of the right femur showed a Grade III open, bicondylar, type C1 fracture of the distal femur, with medial and proximal displacement of the medial femoral condyle, caudal subluxation of the tibia relative to the femur, and patella alta, consistent with caudal cruciate ligament and patellar ligament rupture (▶Figure 5A and B) (1, 6, 7).

The dog was placed under general anaesthesia and positioned in dorsal recumbency for surgery. A 7 cm diameter laceration was present on the craniolateral aspect of the stifle, extending proximally over the distal femur. The margins of the laceration were extended proximally and distally to expose the femur and proximal tibia. Intra-operatively, the lateral and medial femoral condyles were identified as independently separated from the femoral metaphysis at the level of the intercondylar notch, and the mid-body of the caudal cruciate ligament was transected. The patellar ligament, tendon of origin of the long digital extensor, popliteal tendon, and lateral collateral ligament were also transected (▶Figure 6A and B). The medial femoral condyle was reduced and stabilized to the distal metaphysis using a 3.5 mm cortical bone screw placed in lag fashion and a Kirschner wire. Because of the lack of interdigitation and the oblique configuration of the medial femoral condylar fracture, a seven-hole 2.7 mm locking plate[d] was applied medially as a neutralization plate (▶Figure 6C). Due to the small size of the condylar fragment and the limited bone available for adequate screw purchase in the proximal fragment, five diverging Kirschner wires were used to reduce and stabilize the lateral femoral condyle (▶Figure 6D). Primary repair of the lateral collateral ligament was performed with metric 4 polydioxanone suture[e] in a locking loop pattern. The repair was augmented by anchoring the ligament to a 2.7 mm screw and washer inserted at the femoral insertion of the lateral collateral ligament. The mid-body caudal cruciate ligament transection was not repaired. The patellar ligament was repaired with a Bunnell-Mayer pattern using metric 4 polypropylene suture[e] and horizontal mattress pattern using polydioxanone suture. The repair was augmented with a loop of 1.2 mm diameter orthopaedic wire passing distally through a

d SOP™: Orthomed, Vero Beach, FL, USA

e PDS II: Ethicon, Somerville, NJ, USA

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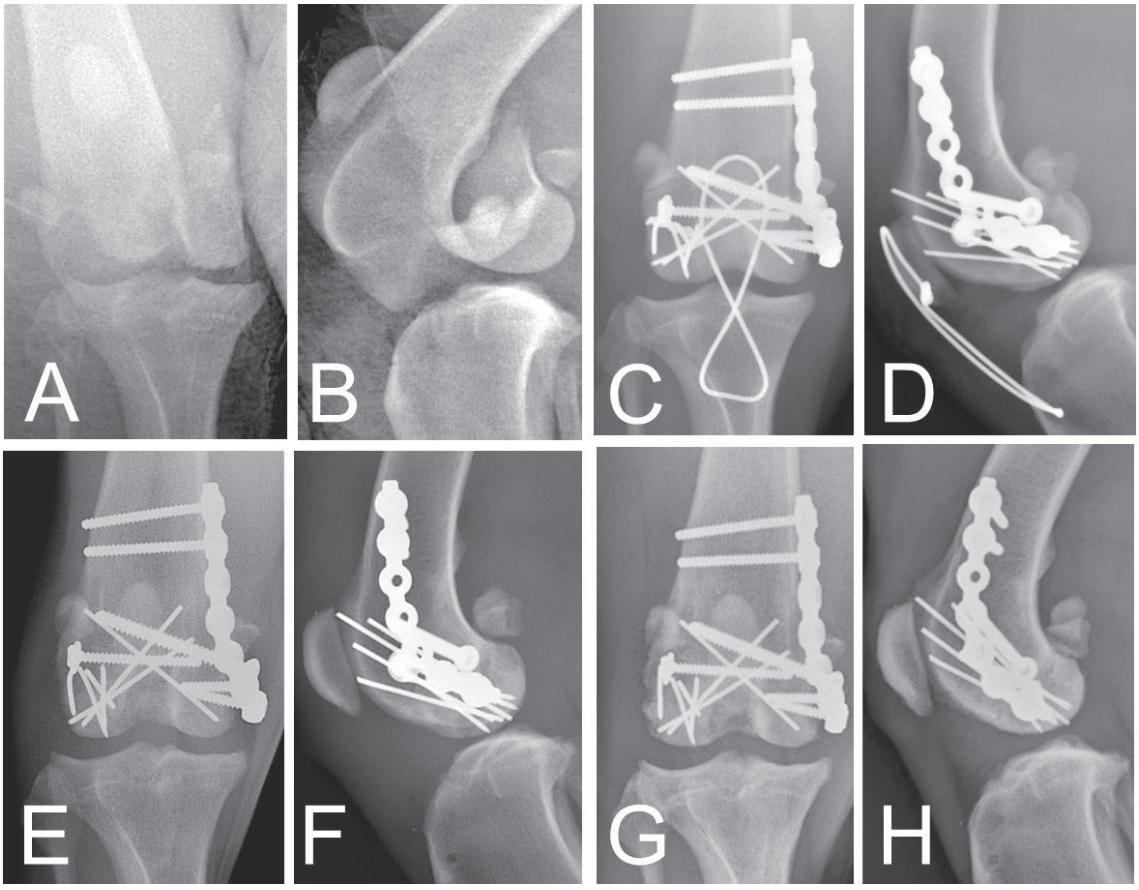

Figure 5 Preoperative radiographs of a six-year-old dog (case 3) with an open, complex fracture of the right distal femur along with a severed lateral collateral ligament, patellar tendon, long digital extensor and popliteal tendon **(A, B)**. The fracture was repaired with a 3.5 mm cortical bone screw placed in a lag fashion, a seven-hole 2.7 mm SOP plate on the medial aspect of the distal femur and five diverging Kirschner wires A figure-of-eight wire was placed from the tibial tuberosity to the patella **(C, D)**. The figure-of-eight wire was removed four weeks postoperatively. Radiographs taken three months postoperatively showed a healed distal femoral fracture with static femoral orthopaedic implants **(E, F)**. Radiographs taken two years postoperatively showed progressive mild to moderate right stifle osteoarthritis, with static distal femoral orthopaedic implants **(G, H)**.

tunnel made in the tibial tuberosity, and proximal to the patella, within the patellar ligament (▶Figure 5C and D) (12). The lateral fascia was imbricated using metric 3.5 polydioxanone suture[e] and the site was closed routinely. External coaptation was applied with the stifle in full extension to protect the patellar ligament repair. The dog was discharged with orders to the owner to restrict activity and administer carprofen (2 mg/kg orally every 24 hours), tramadol (2 mg/kg orally every 12 hours, as needed for pain), cephalexin (33 mg/kg orally every 12 hours), and acepromazine (0.4–0.8 mg/kg orally every 8–12 hours, as needed for sedation).

Four weeks postoperatively the orthopaedic wire and external coaptation were

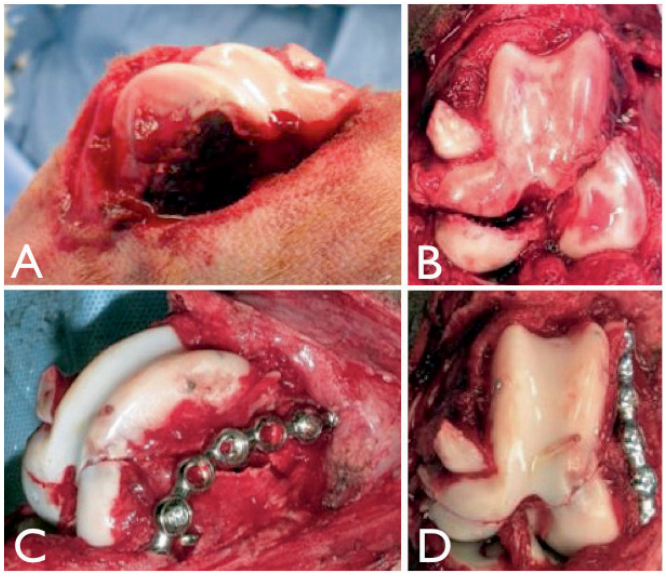

Figure 6 Intra-operative images of an open, complete fracture of the right distal femur with a severed lateral collateral ligament, patellar ligament, long digital extensor and popliteal tendon in case 3 before repair **(A, B)** and after repair **(D, E)**.

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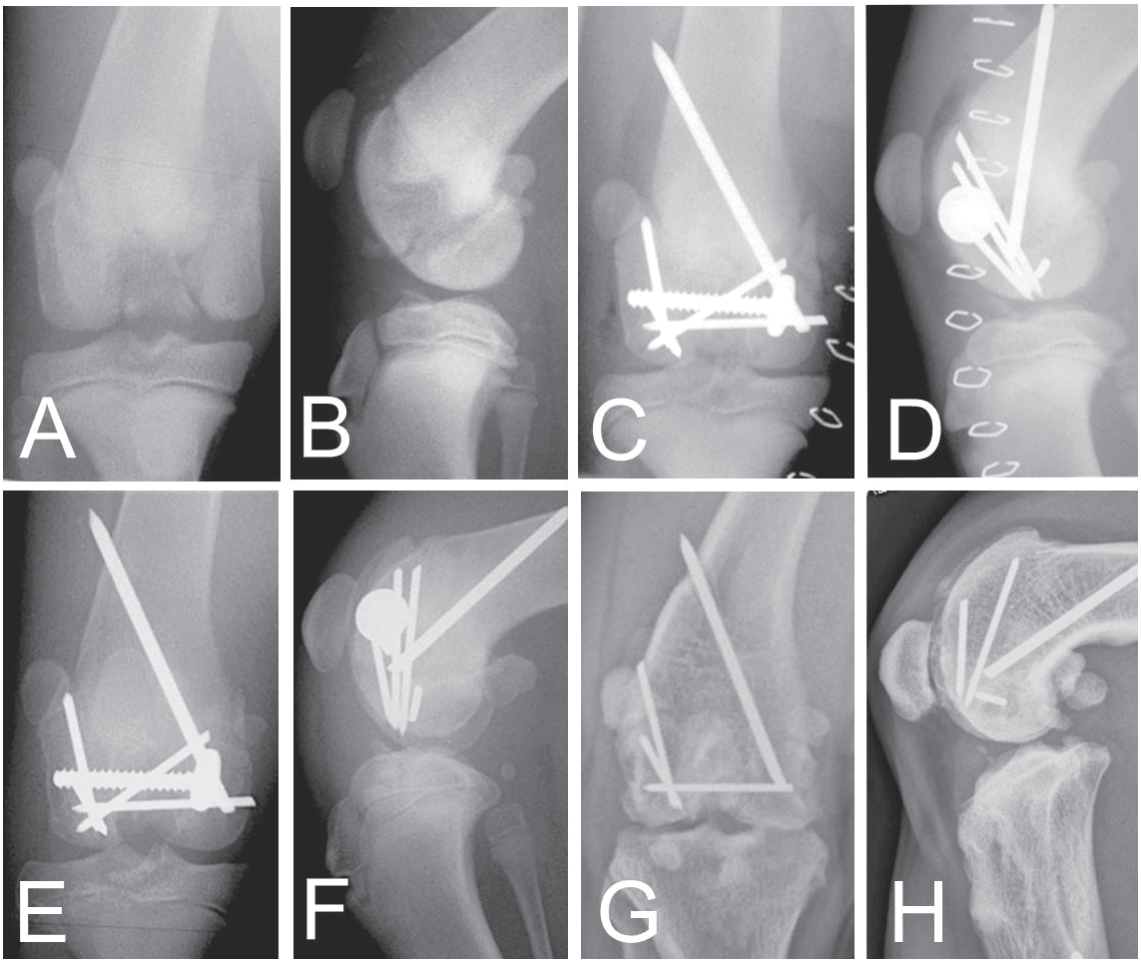

Figure 7 Preoperative radiographs of a three-month-old mixed breed dog (case 4) with a complex Salter Harris type IV fracture of the right distal femur with suspected avulsion of the CrCL **(A, B)**. The fracture was repaired with a 3.5 mm cortical bone screw placed transcondylar in a lag fashion and additional Kirschner wires were placed to maintain the condylar fragments in reduction **(C, D)**. Radiographs at the one month follow-up showed a healing right distal femoral fracture **(E, F)**. Radiographs taken at the seven year follow-up showed evidence of moderate to severe osteoarthritis, moderate stifle effusion and thickening of the patellar ligament **(G, H)**.

removed, and physical therapy consisting of range-of-motion exercises and controlled leash walks was initiated. Three months post-wire removal, the dog had full activity with mild lameness and moderate muscle atrophy of the right hindlimb. Orthogonal radiographs revealed complete healing of the right distal femoral fractures (▶Figure 5E and F).

Follow-up examination two years postoperatively revealed mild lameness of the right hindlimb on visual gait assessment (▶Table 1). No crepitus was detected upon palpation of the stifle, and there was no evidence of joint instability. Goniometric measurements of the stifle, circumference of the mid-thigh, length of the affected femur relative to the contralateral femur, and peak vertical force at a trot obtained at long-term recheck examination are summarized in ▶Table 2. Orthogonal radiographs showed progressive right stifle osteoarthritis, with no changes associated with the implants (▶Figure 5G and H). The owners reported that the dog had regained full activity but had episodes of mild right pelvic limb lameness, and long-term outcome was rated as good based on owner's assessment of quality of life and satisfaction (9).

Case 4

A three-month-old, 15 kg, entire male, mixed breed dog was presented for evaluation of the pelvic limbs after being hit by a car. The dog was non-ambulatory in the pelvic limbs, and crepitus and pain were detected on palpation of the proximal left tibia and the right stifle. Orthogonal radiographs of the right femur revealed a bicondylar, Salter-Harris Type IV of the distal femur, consistent with a type C3 fracture, with separation of the intercondylar notch (1, 8). Orthogonal radiographs of the left tibia revealed a comminuted fracture of the proximal left tibial diaphysis, with mild cranial displacement of the distal segment and overriding, along with a segmental fracture of the left proximal fibular diaphysis (▶Figure 7A and B).

The dog was placed under general anaesthesia and positioned in dorsal recumbency. The right stifle was exposed through

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a craniomedial parapatellar approach, extending proximally over the distal femur. Intra-operative findings included a bicondylar, Salter-Harris Type IV fracture, with separation of the intercondylar notch and an avulsion fracture of the origin of the cranial cruciate ligament (8). Following anatomical reduction, a 3.5 mm transcondylar cortical screw placed in lag fashion and several Kirschner wires were used to stabilize the fractures. Before tightening the screw, the intercondylar notch was reduced with a transcondylar Kirschner wire. Compression with the transcondylar lag screw provided additional stabilization to the intercondylar notch and the avulsed origin of the cranial cruciate ligament (▶Figure 7C and D). The left tibial fracture was stabilized with a Type I external skeletal fixator applied medially.

Follow-up orthogonal radiographs one month postoperatively revealed healing of the distal right femoral fracture and osseous callus bridging the left tibial and fibular fractures (▶Figure 7E and F). The external skeletal fixator was explanted from the left tibia under general anaesthesia. The dog was presented five years later for evaluation of an acute onset, left pelvic limb lameness and was diagnosed with a complete rupture of the left cranial cruciate ligament based on physical examination and radiographs. Owners elected surgical treatment with a left cranial tibial closing wedge osteotomy (13).

Follow-up examination performed seven years postoperatively revealed a moderately stiff gait with a moderate lameness of the right hindlimb on visual gait analysis (▶Table 1). Crepitus and thickening were detected at palpation of the stifle, but no evidence of joint instability was found. Goniometric measurements of the stifle, circumference of the mid-thigh, length of the affected femur relative to the contralateral femur, and peak vertical force at a trot could not be obtained due to relocation of the patient. Orthogonal radiographs revealed moderate to severe right stifle osteoarthritis, moderate stifle effusion, and thickening of the patellar ligament (▶Figure 7G and H). The owner reported that the dog had regained full activity and long-term outcome was rated as good based on owner's assessment of quality of life and satisfaction (9).

Discussion

Our findings from a review of these four cases indicate that bicondylar femoral fractures complicated by ligament or tendon injuries of the stifle may have a good prognosis when treated with rigid anatomical fixation, as previously reported for unicondylar fractures (5, 14). All dogs in this study had a good to excellent long-term outcome based on their return to full activity, despite the development of osteoarthritis. The dogs presented in this report had soft tissue injuries associated with bicondylar distal femoral fractures. All three skeletally-immature dogs (cases 1, 2 and 4) had avulsion of either the cranial or the caudal cruciate ligaments together with a separation of the intercondylar notch. One proposed aetiology for this fracture pattern in immature dogs is propagation of the fracture line through the physis along the path of least resistance through the intercondylar notch, as reported in children (15). In the skeletally-immature patient, the ligaments are stronger than the physis; therefore, injuries that normally affect ligamentous structures in adults often result in physeal fractures and concomitant anterior cruciate ligament injuries in children (16, 17). The tensile forces exerted by the cruciate ligaments, with resultant avulsion of their origins, combined with the physeal fracture, may have contributed to the fracture configurations in these cases. Stabilization of the notch fragments was possible with concurrent anatomical reduction and rigid fixation of the major condylar fragments. For this reason, in two dogs with avulsions of the origins of the caudal (case 1) and cranial (case 4) cruciate ligaments, no further stabilization was utilized.

Caudal cruciate ligament injury was identified in three of the four dogs in this series (case 1, 2 and 3). In two dogs with partial avulsions of the origin of the caudal cruciate ligament a repair could be performed (case 1 and 2); the dog with a mid-body transection (case 3) was treated conservatively. Despite conservative treatment, this dog had no gross instability detected by palpation of the stifle at follow-up examination. In people, posterior cruciate ligament injuries are usually a result of injuries at the point of insertion, such as tibial plateau avulsion fractures, and are associated with a guarded prognosis for return to function due to compromise of the physis and the proximity of neurovascular structures during surgical repair, along with the technically-demanding nature of the reconstructive procedure (18, 19). Previous studies demonstrated that people with posterior cruciate ligament-deficient knees regained acceptable functional outcome, however, more recent studies advocate surgical repair of the posterior cruciate ligament in order to optimize return to function, as well as prevent further injury from the altered kinematics and loading within the knee (20–22). A previous study in dogs demonstrated that experimental transection and partial excision of the caudal cruciate ligament resulted in minimal to no lameness three months post-transection, suggesting that conservative treatment of caudal cruciate ligament in the dog may provide acceptable functional outcome (23). We suspect that the stability of the stifle joint of the dog treated conservatively occurred as a result of the development of postoperative fibrosis.

In dogs, the distal femoral physis is responsible for 65–75% of femoral longitudinal growth, and it typically closes between 25–33 weeks of age (2). Insult to the distal femoral physis, during the time of injury or during surgical repair, may result in femoral shortening and angular limb deformity in up to 82% of dogs (24). Three of the cases in this series (case 1, 2, and 4) were identified as Salter-Harris Type IV fractures of the distal femur. The largest discrepancy in femoral length occurred in case 1, in which the affected femur was 9.6% shorter than the contralateral femur. While femoral shortening did occur in some cases, femoral length discrepancy did not appear to cause significant lameness. Premature eccentric closure of the medial aspect of the distal femoral physis in case 2 was probably due to the original trauma, as well as the extensive intra-operative manipulation during fixation of the fracture fragments.

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In conclusion, we demonstrated that severe ligament and tendon injuries can be associated with bicondylar fractures of the femur in the dog and the integrity of the ligaments and tendons of the stifle should always be assessed during the management of these types of fractures. Our results suggests that the prognosis for dogs with bicondylar fractures of the femur can be favourable if the trauma is managed with anatomical reconstruction and rigid fixation, as well as repair of concurrent soft tissue injuries where possible.

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Conflict of interest

None declared.

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