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Tibial tuberosity avulsion fracture repair using Kirschner wire in a dog: A case report

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Abstract

A five-month-old female Beagle dog weighing 7 kgs was presented with a complaint of trauma as a result of jumping from a height, exhibiting lameness and pain in the left pelvic limb. Upon examination non weight bearing lameness, pain on palpation and soft tissue swelling at the stifle region of left pelvic limb was noticed. Radiographic examination revealed an avulsion fracture of the tibial tuberosity. Surgical intervention was conducted using two, Kirschner wires of 2mm driven through the avulsed fracture and across physis to lodge in the proximal tibia plateau. A Thomas splint was placed and maintained for 2 weeks postoperatively and changed weekly. Animal demonstrated an uncomplicated recovery, achieving fracture stabilization using a Kirschner wire with full functional restoration of the affected limb.

Keywords: Tibial tuberosity, avulsion fracture, Kirschner wire, Thomas splint

Introduction

Tibial fracture is more common in small animals and corresponds to 15 to 21% of long bone fractures and 11.7% of appendicular fractures in dogs (Dias *et al.*, 2018) [3]. In dogs, the proximal tibia is formed by the union of the tibial apophysis, proximal tibial epiphysis and proximal tibial metaphysis (Clements *et al.*, 2003) [1]. The proximal tibia has 2 ossification centres. These are, the proximal tibial epiphysis and the tibial tuberosity apophysis. The tibial tuberosity apophysis and proximal tibial epiphysis fuse in the 7-8 months period before uniting with the tibial metaphysis. In skeletally immature dogs, trauma to the proximal tibia causes avulsion of the tibial tuberosity apophysis and fracture of the proximal tibial physis. Occasionally both may occur simultaneously (Pratt, 2001; Clements *et al.*, 2003) [10, 1]. Tibial tuberosity avulsion fractures (TTAF), previously known as Osgood-Schlatter disease, represent a small proportion of proximal tibial fractures in dogs (Pfeil *et al.*, 2009; Tobius, 2017) [6, 5]. Avulsion fractures of the tibial tuberosity are rarely encountered. They are generally seen in young animals aged between 4-8 months. They occur more frequently in Greyhound and Terrier breeds (Piermattei *et al.*, 1997; Pratt, 2001; Clements *et al.*, 2003) [8, 10, 1]. The tibial tubercle acts as the point of insertion for the quadriceps muscle via the patellar ligament. Avulsion fractures occur due to muscle contractions observed during hyperflexion of the stifle joint. A similar mechanism may easily develop through jumping, running or falling. Clinically, the detached tibial tuberosity can be palpated, dislocated proximally and the distal part may rotate cranially. At the same time, the patella moves towards the proximal of the femoral trochlear groove. This condition may be seen radiographically while being undetectable via palpation. For definite diagnosis, a lateral radiograph is taken of the leg in flexion. If dislocation is suspected, a radiograph taken of the sound leg will help with the assessment (Piermattei *et al.*, 1997; Pope *et al.*, 1998; Denny *et al.*, 2000) [8, 9, 2].

Treatment methods of avulsion fractures are conservative and surgical. Withrow *et al* (1976) [12] found that 21/21 dogs (two treated conservatively and 19 treated surgically) functioned normally on the affected limb. Various surgical techniques for repositioning TTAF have been described, including methods that involve Kirschner wires with or without a tension band, and lag screws (Piermattei *et al.*, 1997) [8]. The most frequently encountered complication following surgery is

medial luxation of the patella (Pratt, 2001) ^[10]. Other complications include: delayed union because of loose implant, broken implant (Withrow *et al.*, 1976) ^[12]. The purpose of this report was to describe the surgical stabilization of rarely encountered avulsion fractures of tibial tuberosity using Kirschner wires.

Materials and Methods

A five-month-old female Beagle dog weighing 7 kgs presented to Department of Surgery and Radiology, Veterinary College Hebbal, Bengaluru, with a complaint of 4-day old left pelvic limb injury as a result of jumping from a height while playing and exhibiting lameness and pain. Clinical examination indicated non-weight bearing lameness, soft tissue swelling and pain upon palpation of stifle region of left pelvic limb. A medio-lateral radiographic view of left stifle revealed an avulsion fracture of the tibial tuberosity (Fig. 1). All the haematological and biochemical parameters were in normal range. It was determined that surgical intervention necessary for treating the fracture. The dog was initially premedicated with Inj. Atropine sulphate (0.04mg/kg) intramuscularly, Inj. Xylazine (1mg/kg) intramuscularly. Pre operative antibiotic (Ceftriaxone at a dosage of 25 mg/kg intravenously) and pre-emptive analgesic (Meloxicam at a dosage of 0.2 mg/kg intramuscularly) was administered. Induction and maintenance of Anaesthesia was achieved by using 2.5% Thiopental sodium intravenously to the effect. The surgical site was prepared aseptically and draping was done exposing the surgical site for skin incision.

A longitudinal skin incision lateral to patella, the patellar ligament and the tibial tuberosity was made. Then avulsed fracture was accessed by separating muscles from proximal part of tibia and by incision of joint capsule in same manner. Fibrous present in between the avulsed tibial tuberosity and tibia were scrapped. The avulsed fragment was pulled distally and placed in its normal position. Two Kirschner(K) wire, each with a diameter of 2 mm, were driven through the avulsed fracture and across the physis to lodge in proximal tibial plateau. Then protruding ends of wire were bent 90° using K wire bender and were then cut leaving ½ cm behind (Fig. 2). Joint capsule, muscles and subcutaneous tissue were closed routinely using Polydioxanone No. 2-0. Skin was closed by horizontal mattress using Polyamide No. 2-0 and Bandaging was done. A Thomas splint was placed for immobilization and to protect the repair. Post-Operative management included administering Cephalexin (25mg/kg) BID, Carprofen (3mg/kg) SID orally for 7 days and 3 days respectively. Skin sutures were removed on 15th post-operative day. Home based passive range of motion (PROM) exercises were recommended once the Thomas splint was removed after 2 weeks of surgery.



Fig 1: Pre-operative radiograph of medio-lateral view showing avulsion fracture of cranial tibial tuberosity



Fig 2: Surgical procedure, A: Exposure of joint capsule, B: Drilling of K-wires through avulsed fracture into proximal tibial plateau after anatomical reduction, C: K-wire bent 90° using K-wire bender, D: Excess part of K-wire was cut leaving ½ cm behind.

Results

Surgically managed fracture of avulsed tibial tuberosity healed with no major nor minor complications postoperatively. The lameness score was evaluated pre-operatively and post operatively on 0th, 15th, 30th and 60th day as per Pfeil *et al.* (2012) ^[7]. Prior to surgery, animal exhibited lameness of Grade 4 (Non weight bearing at rest and while walking). Grade 3 lameness (Toe-touching weight-bearing at rest and non-weight bearing when walking) was achieved at 15th post operative day and Grade 2 lameness (Toe-touching weight-bearing at rest and when walking). Further it progressed to achieve Grade 1 lameness (Normal weight-bearing at rest but favouring of the limb when walking) by 60th post operative day. This might be due to adequate stabilisation of the fracture fragments and implants mechanical rigidity.

Immediate post-operative radiographs after surgery showed proper positioning of the K-wires providing correct apposition of the fracture fragments (Fig. 3). 15th post-operative day radiographs revealed no alteration in position of K-wires and wires in-situ. (Fig. 4). 30th day post-operative radiographs of the stabilized limb revealed no alteration of K-wires with visible callus formation bridging the fracture fragments of tibia. There was also a reduction in the fracture gap indicating fracture healing process (Fig. 5). 60th post-operative day radiographs revealed good evidence of callus formation and decrease in width of fracture line demonstrating satisfactory bone healing with no complications of bone (Fig. 6). This implies that stable and rigid fixation of fracture by implants contributed to callus formation and fracture healing process.



Fig 3: Immediate Post-operative Radiographs



Fig 4: 15th day Post operative Radiographs



Fig 5: 30th day Post operative Radiographs



Fig 6: 60th day Post operative Radiographs

Discussion

In small animal practice, avulsion fractures of the tibial tuberosity are rare and not frequently encountered. Avulsion fracture of tibial tuberosity occurs more often in 4-8 months old young animals since growth plates are weaker in comparison to bone and mostly in relation to trauma as a result of jumping, running or falling. The tibial tuberosity acts as the point of insertion for the quadriceps muscle via the patellar ligament. Muscle contractions resulting in the hyperflexion of the stifle joint cause avulsion fracture of tibial

tuberosity. This was supported by (Piermattei *et al.*, 1997; Pratt, 2001; Clements *et al.*, 2003) [8, 10, 1]. In our case age of animal was 5 months old and fracture caused by trauma as a result of jumping from a height while playing. Clinical examination revealed that the dog was unable to use the affected limb, a swelling and soft tissue damage was present in the stifle region along with pain. These clinical findings are consistent with findings reported in literature of Pope *et al.* (1998) [9], Denny *et al.* (2000) [2]. Although fractures of the proximal tibial epiphysis are typically reported to occur alongside avulsion of the tibial tuberosity apophysis by (Pratt, 2001; Clements *et al.*, 2003) [10, 1] but it was not encountered in our case. In the treatment of avulsion fractures, tension band wire along with Kirschner wires is usually preferred. However, reports of Schmokel *et al.* (1995) [11], Piermattei *et al.* (1997) [8], Pratt (2001) [10] suggest that this method may lead to early closure of the growth plate at the fracture site, potentially resulting in deformity over time. In accordance with this reasoning, only Kirschner wires of diameter 2mm were used for treatment of avulsion fracture of tibial tuberosity. While it has been previously indicated that medial patellar luxation by Pratt (2001) [10], tibial tuberosity deformation and premature closure of the growth plate after surgery by Goldsmid and Johnson (1991) [4] may develop as a complication following avulsion of tibial tuberosity, no such complications were detected during the post-operative clinical and radiographic follow-up of the case. Home-based passive range of motion (PROM) exercises were recommended following removal of Thomas splint, may have facilitated early functional limb use while mitigating the risk of joint deformities.

Conclusion

The surgical stabilization technique by two Kirschner wires described in this report to address the tibial tuberosity avulsion fracture in a dog yielded a positive clinical outcome demonstrating effectiveness in the surgical approach, functional recovery, bone stability, and fracture fixation.

Conflict of Interest

Not available

Financial Support

Not available

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