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Treatment of Proximal Tibial Fractures By Cross Pin Fixation in Dogs

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Abstract: The study material was composed of nine dogs 2.5-9-month-old which were brought to the Clinic of the Surgery Department, Faculty of Veterinary Medicine, University of Ankara between 1992 and 2001 with proximal tibial fractures diagnosed with clinical and radiographic examinations. The incidence of proximal tibial fractures was much lower than that of other tibial fractures in this period. Under the Salter-Harris classification, 2 cases were of type I, 5 cases were of type II and 2 cases had metaphyseal transversal fractures detected using radiographic and clinical examinations. For treatment of proximal tibial fractures in cases with dynamic growth periods, the cross pinning fixation technique can be used, which affects growth plates much less and can be recommended for this kind of fracture. Depending on size Kirschner wire and Steinmann pins were used and evaluated over periods extending to 5.5 months. During this period there were no differences or complications in the healing period, normal closure of the growth plate was observed between the relevant side and the opposite side, and all cases were treated functionally. No difference was recorded in terms of the mean of complication occurrence. At the end of this clinical study, we concluded that the cross pinning technique can be used for reduction on proximal tibial fractures in dogs in the growing period. In addition our study shows that this treatment method does not cause early closure of growth plates and is a very functional way of treating proximal tibial fractures in immature dogs.

Key Words: Cross pin, dog, intramedullary fixation, proximal tibial fractures.

Köpeklerde Proksimal Tibia Kırıklarının Çapraz Pin Tekniği ile Sağaltımı

Özet: Ankara Üniversitesi Veteriner Fakültesi Cerrahi Anabilim Dalı kliniklerine 1992-2001 yılları arasında getirilen, klinik ve radyolojik muayeneleri sonucunda, değişik tipte proksimal tibia kırığı belirlenen ve yaşları 2.5-9 aylık olan 9 köpek, çalışma materyalini oluşturdu. Bu dönem içerisinde köpeklerde rastlanılan tibia kırıklarının oldukça yaygın olmasına karşın, proksimal tibia kırıklarının sayıca az olduğu görüldü. Bu olgularda Salter-Harris sınıflandırmasına göre 2 olguda tip I, 5 olguda tip II kırığı, 2 olguda ise metafizyel transversal kırık belirlendi. Büyüme döneminde bulunan olgularda tibia'nın proksimal büyüme plağının en az etkilenebileceği sağaltım seçeneklerinden biri olan çapraz pin tekniği ile redüksiyon sağlandı. Olgunun büyüklüğüne göre seçilen farklı çaplarda Kirschner ve Steinmann pinleri ile sağlanan redüksiyon sonrasında, olgular 5.5 aya kadar değişen sürelerde izlendi. Bu izleme döneminde, ilgili ekstremiteler ile diğer ekstremiteler arasında büyüme plaklarının kapanmasına ilişkin bir farklılık ve komplikasyonla karşılaşmaksızın olgularda fonksiyonel iyileşme sağlandı. Bu klinik çalışma sonucunda; özellikle büyüme dönemindeki köpeklerde proksimal tibia kırıklarında uygulanan çapraz pin tekniği ile yeterli redüksiyonun sağlanabileceği gözlemlendi. Ayrıca bu uygulamanın, immatür köpeklerde büyüme plağının erken kapanmasına neden oluşturmayacak fonksiyonel bir sağaltım yöntemi olduğu belirlendi.

Anahtar Sözcükler: Çapraz pin, köpek, intramedullar fiksasyon, proksimal tibia kırıkları.

Introduction

Tibial fractures, which are frequently observed in small animals, comprise 21% of long bone and 11.7% of total limb fractures (1,2). Fractures including the

proximal part of the tibia are very common and comprise 7% of tibial fractures (1). They are commonly simple fractures and multi-fragmented fractures are rarely observed. Tibial fractures are predisposed as open

fractures due to the smaller amount of soft tissue surrounding the bone (2,3).

Proximal tibial fractures commonly occur in the epiphysis and metaphysis in immature dogs (2). During the growth period in dogs, the bones have less resistance than do the ligaments of the stifle joint. Most of the proximal physeal fractures occurring in this period are Salter-Harris (S-H) type I and II fractures. In physeal fractures with the avulsion of tibial tuberosity, the whole epiphysis dislocates caudally or caudolaterally (1,2,4,5).

In cases of physeal fracture, the possibility of lesions of the ligament and menisci should be taken into consideration, and the stifle should meanwhile be carefully examined (3).

In some cases, closed reduction without total anatomical reduction may be adequate. An externally supported splint can be applied for 2-4 weeks with the stifle joint in its normal functional position for this kind of management (1,2).

Most cases require open reduction to relocate the epiphysis to its normal position. S-H type I and type II fractures in particular, which cannot be treated by closed reduction, and S-H type III and IV fractures should be operated on (1,2).

There are various types of methods for the management of proximal physeal tibial fractures. Intramedullary Steinmann pin fixation, or 2 Rush pins or bone plates can be applied intramedullary. Cross pin fixation using Kirschner wires or small diameter Steinmann pins can provide complete stabilisation (1-3,5,6). Especially in growing dogs, fixation provided by intramedullary pinning is recommended to preventing premature closure of the growth plate (7).

In growing dogs, bone screws used as a fixation devices must be removed as early as possible in order not to affect the growth plate, and this period should be up to 6 months in large and medium sized dogs and 3.5-4 months in small breeds. Intramedullary pins can be left in place unless loss of function and pin loosening is present (1).

The aim of this study was to evaluate the functional, clinical and radiological results of proximal tibial fractures, which are uncommon in growing dogs, using the cross pin technique.

Materials and methods

The study material consisted of 9 dogs brought to the Clinic of the Surgery Department, Faculty of Veterinary Medicine, University of Ankara, between 1992 and 2001 with proximal tibial fractures diagnosed by clinical and radiographic examinations (Table).

Kirschner wires 1 mm in diameter and Steinmann pins 2 mm in diameter were used for the cross pin technique.

Dogs were placed in lateral recumbency under general anesthesia. A lateral patellar incision was made beginning from the proximal margin to 1-2 cm under the tibial tuberosity. The subcutaneous tissue and fascia were incised from the same incision line. The fracture line was exposed by elevating the tibialis cranialis muscle from the lateral surface of the proximal tibia. In some cases arthrotomy of the stifle was performed. Reduction was managed by traction and elevation of the metaphysis caudally and of the epiphysis in the same and opposite direction. Kirschner wires or Steinmann pins were inserted distally from the nonarticular surfaces of the lateral and medial epiphysis without crossing each other at the fracture line. The area was closed routinely.

The function of the affected limb was graded according to the following criteria: *Good* indicates no gait abnormality, the dog can run, jump and turn without lameness and no pain is detected at clinical examination; *Fair* indicates that although the dog is persistently lame, it has reasonable use of the limb; *Poor* indicates the dog bears weight periodically or not at all and is in obvious pain.

While the externally supported splint was applied for 12 days and antibiotics were administered intramuscularly for 5 days postoperatively (Lincospectin, 50 mg of lincomycin hydrochloride + 100 mg of spectinomycin sulphate tetrahydrate/ml, Eczacıbaşı).

The bandages and sutures were removed on the 12th day postoperatively. The weight bearing capacity of the limb was monitored.

Results

Radiographic evaluation of these 9 cases of proximal tibial physeal fracture revealed that 2 dogs had transversal metaphyseal fractures (Figure 1), 2 dogs had epiphyseal S-H type I fractures (Figure 2) and 5 dogs had epiphyseal S-H type II fractures (Figure 3). The dogs

Table . Findings regarding cases

Case number	Cases				Lesions			Results
	Breed	Age	Sex	Causes	Localisation	Fixation materials		
1	Crossbreed	5 months	F	FHP*	Left tibia, metaphyseal, transversal	Steinmann pin 2 mm in diameter	Clinical functional, good result, one pin removed due to pin loosening	
2	Belgian shepherd dog	2.5 months	M	Unknown	Right tibia metaphyseal, transversal	Steinmann pin 2 mm in diameter	Clinical functional, good result	
3	Terrier	2.5 months	M	Unknown	Right tibia S-H*** Type I	Steinmann pin 2 mm in diameter	Clinical functional, good result	
4	German shepherd dog	9 months	F	MVA**	Left tibia S-H type II	Steinmann pin 2 mm in diameter	Clinical functional, good result	
5	Collie	6 months	M	MVA	Left tibia S-H Type II	Kirschner wires 1mm in diameter	Clinical functional, good result	
6	Turkish shepherd dog	6 months	M	MVA	Left tibia S-H Type I	Steinmann pin 2 mm in diameter	Clinical functional, good result	
7	Rottweiler	5 months	F	MVA	Left tibia S-H type II	Steinmann pin 2 mm in diameter	Clinical functional, good result	
8	Crossbreed	6 months	M	MVA	Right tibia S-H Type II	Steinmann pin 2 mm in diameter	Clinical functional, good result	
9	Crossbreed	3 months	M	MVA	Right tibia S-H type II	Kirschner wires 1mm in diameter	Clinical functional, good result	

* FHP (Falling from high places)

** MVA (Hit by car)

*** S-H (Salter-Harris type fractures)



Figure 1. Transversal metaphyseal fracture in case 1.



Figure 2. Salter-Harris (S-H) type I fracture in case 6.

which were in their growth period, between the ages of 2.5 and 9 months, were treated with the cross pin technique (Figures 4-6) and were followed up over a period of 5.5 months (Figure 7). While 1 of the cross pins was removed due to pin loosening in 1 case, the other pins were left in situ (Figure 8). At clinical evaluation all the dogs achieved good clinical results (Table).



Figure 3. Salter-Harris (S-H) type II fracture in case 5.



Figure 4. Cross pin fixation technique in metaphyseal fracture in case 1.



Figure 5. Cross pin fixation technique in S-H type I fracture in case 6.

There were no major abnormal effects detected on growth potential according to the clinical and radiological findings.

Discussion

It was determined that tibial fractures in small animals are common and that most proximal tibial fractures are simple fractures, which are uncommon (1,2).

It was determined that the 9 dogs included in this study had simple fractures.

Tibial fractures are predisposed to open fractures due to the smaller amount of soft tissue. The diaphysis and distal parts are less surrounded by soft tissue than is the proximal part of the bone (2,3). All of the proximal tibial fractures in this study were closed fractures.

It was determined that tibial fractures in immature dogs occurred at the epiphysis and metaphysis (2). Epiphyseal fractures were detected in 7 cases which was in agreement with the literature.

Most of the proximal epiphyseal fractures in young dogs were S-H type I and type II fractures (1,2). S-H type



Figure 6. Cross pin fixation technique in S-H type II fracture in case 5.



Figure 7. Radiographic evaluation of case 5 on day 165 (approximately 5.5 months) postoperatively.



Figure 8. Radiographic evaluation of case 1 on day 60 postoperatively (One pin removed as a result of pin loosening).

I was encountered in 2 dogs with epiphyseal fractures and S-H type II fractures were encountered in 5 cases.

Closed reduction may be adequate in cases of proximal tibial fractures, but most cases required open reduction (1,2). All the cases in this study were managed by open reduction.

Perfect reduction can be achieved by cross pin application using Kirschner wires or small diameter Steinmann pins (1-3,5,6). Young animals with growth potential in particular require pin fixation to prevent premature closure of the growth plate (7). Perfect reduction was achieved in all the growing dogs using cross pin with Kirschner wires or Steinmann pins, and it was determined that the application did not cause premature closure of the growth plate.

Pins may be left in place unless there is loss of function or pin loosening (1). In our first case one of the pins was removed as result of pin loosening, while there were no complications and the pins were left in place in the rest of the cases.

In conclusion, it was observed that perfect reduction can be achieved by using the cross pin technique in growing dogs with proximal tibial fractures. It is suggested that cross pin fixation is the preferable treatment technique in immature dogs.

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