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Minimally Invasive Arthroscopic-Assisted Reduction with TightRope® for Coxofemoral Luxation in a Korean Water Deer (*Hydropotes inermis argyopus*)

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Abstract : A Korean water deer was rescued with non-weight-bearing lameness of the right hind limb. Clinical and radiographic examination revealed a craniodorsal coxofemoral luxation. The cause of the right coxofemoral luxation (CL) was unknown. We performed minimally invasive arthroscopic-assisted reduction with toggle pin fixation (mini TightRope®). Craniodorsal CL in the water deer was reduced and stabilized successfully. At 60 days after admission, the water deer was successfully released back into the wild. This minimally invasive surgical technique can be used to correct coxofemoral luxation in wild animals.

***Key words* :** Korean water deer, minimally invasive surgery, TightRope®, coxofemoral luxation, arthroscope.

Introduction

Korean water deer (*Hydropotes inermis argyopus*) are widespread across the entire Korean peninsula and are found in rural areas and near large cities (9). Fracture and luxation of the legs are common traumatic disorders in deer. The main cause of injury is trauma due to road traffic accidents (15). In small animal medicine, coxofemoral luxation is treated by closed reduction or surgical stabilization with open reduction (16). In the event that closed reduction fails, open reduction is required (2,10). However, surgical stabilization of joints may lead to problems for released wild animals. Our surgical team reported a minimally invasive arthroscopic method using the mini TightRope® to treat coxofemoral luxation in a dog. This case showed a good outcome and rapid functional recovery (5). The purpose of this report is to describe the surgical technique of minimally invasive arthroscopic-assisted reduction with mini TightRope® in a Korean water deer (*H. i. argyopus*) to treat left coxofemoral joint luxation.

Case

A young, male Korean water deer weighing 12 kg was rescued with non-weight-bearing lameness of the right hind limb and brought to the Chonbuk Wildlife Rescue and Conservation Center at Chonbuk National University. The cause of the right coxofemoral luxation was unknown. The deer was bright and alert. Physical and orthopedic examinations revealed pain and crepitus on the right coxofemoral joint, but there was no neurological abnormality on the affected limb. Radiographs of the right pelvic area showed a craniodorsal coxofemoral luxation, but a fracture around the right coxofemoral joint was not observed (Fig 1). After failure of closed reduction, we decided to perform minimally invasive arthroscopic-assisted reduction with the mini TightRope® Suture-Button Kit (Mini TightRope® System, Arthrex, USA) so as to return the deer to the wild as rapidly as possible.

Anesthesia was induced with medetomidine (60 μg/kg IV, Domitor®, Pfizer Ltd., USA) and ketamine (1.5 mg/kg IV, Yuhan ketamine 50 Inj® Yuhan Corporation, Korea). After intubation, general anesthesia was maintained with isoflurane (2-3%) in oxygen (1.5 L/min). Epidural anesthesia was performed by administration of 2% lidocaine (3 mg/kg, Lidocaine Hcl Dalhan Inj®, Dai Han Pharm).

The surgical region was prepared for aseptic surgery with a mobile C-arm (Fig 2A). The patient was positioned in lateral recumbency. The surgical technique was similar to that reported in our previous article (5). A 30 mm section of skin was incised at the femoral neck. A 1.9 mm arthroscope was placed through the skin incision; an egress port was not

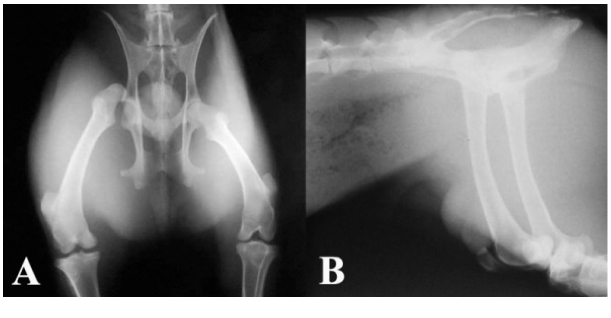

Fig 1. (A) Cranial-caudal and (B) lateral radiograph view of the right coxofemoral joint of a water deer.

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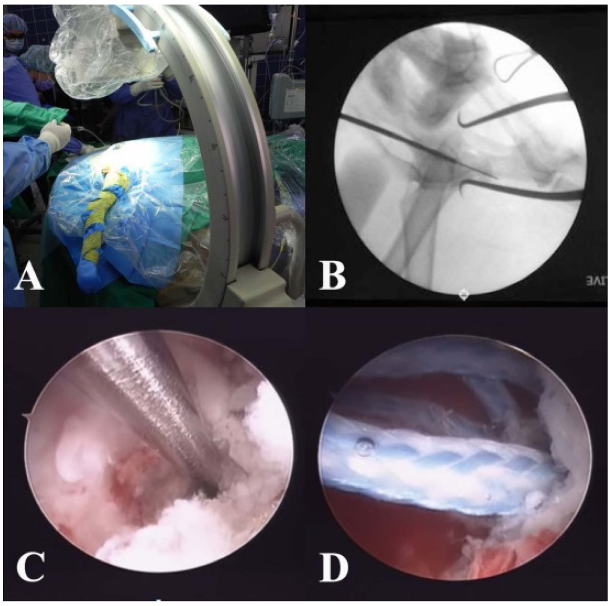

Fig 2. Intraoperative view. The hip was prepared for aseptic surgery with a mobile C-arm. (A) The guide wire was drilled through the acetabulum (B) (C), mini TightRope® was applied in the fossa hole (D).

Fig 3. Postoperative ventrodorsal radiographs. Mini TightRope® button (arrow) is located in pelvic cavity.

placed. Fluid from the incision was aspirated using suction. Under arthroscopy, the hematoma was cleaned and the torn round ligament of the femoral head was debrided. No cartilage damage was found. A guide wire was drilled from the femoral neck through the acetabulum fossa after minimally invasive arthroscopic-assisted reduction of the coxofemoral joint (Figs 2B and C). A 2.7 mm cannulated drill bit was inserted on to the guide wire and advanced until it exited through the other cortical side of the acetabulum under arthroscopy. The mini TightRope® needle was inserted through the femoral tunnel at the coxofemoral joint cavity. The mini TightRope® button was passed to the pelvic cavity through the acetabulum hole by gasping forceps under a 1.9 mm arthroscope (Fig 2D). Each pair of FiberTape® strands was tied with low tension using a tensioner (Suture Tensioner®, Arthrex, USA) after confirming impingement of range-of-motion. The incision site was closed in a routine manner.

After surgery, meloxicam (0.2 mg IM q 24 h, Metacam®, Boehringer Ingelheim Vetmedica, USA) and amoxicillin sodium/clavulanate potassium (5 mg IM q 12 h, CLAMOXIN INJ®, Shin Poong Pharm, Korea) were administered for one week.

Weight bearing increased immediately on the affected limb, but moderate lameness was noticed on the right hindlimb. One month after the surgery, the Korean water deer was capable of full weight-bearing on the right hindlimb and exercised well. The deer was moved to a rehabilitation area with high solid stockade fencing for one month. At 60 days after admission, the water deer was successfully released in the area where he had originally been found.

Discussion

We described reduction and stabilization of craniodorsal CL in a Korean water deer using minimally invasive arthroscopic-assisted reduction with modified Knowles toggle pin fixation. The Korean water deer is one of the most primitive extant deer of the family Cervidae that lives on the Korean peninsula (11). Although traumatic injuries of Korean water deer have rarely been studied, wildlife-vehicle collisions (WVCs) are the major cause of traumatic injuries in Korean water deer (8). A previous clinical study reported treatment results of traumatic injuries in 20 roe deer (*Capreolus capreolus*). There was one hip luxation with acetabular fracture after traumatic injury. This patient recovered after femoral head and neck osteotomy (FHNO) (13). Although FHNO was performed successfully in the wild deer with hip luxation, this deer was not returned to the wild.

Most coxofemoral luxation in dogs occurs as result of being hit by a car (4). Closed reduction with an Ehmer sling is the initial treatment for recent coxofemoral luxation in a dog. However these techniques are associated with a high rate of relaxation, severe muscle atrophy, and poor tolerance in some cats (4). Surgical stabilization with open reduction is performed in the event of chronic luxation, recurrent luxation following closed reduction, pre-existent hip dysplasia, or bilateral lesions (16). Of these surgical-stabilization-with-open-reduction techniques, toggle rod stabilization is an effective treatment option for coxofemoral luxation in small animals (4,14). However, toggle rod stabilization may have the postoperative complications of relaxation due to failure of the toggle rod and/or suture material (4,14). Biomechanical studies reported that polyethylene suture materials and manufactured toggle rods have greater stiffness and lower relaxation rate (1,3,7). Although, TightRope® was not assessed in comparison with the other toggle rod and suture materials in these previous biomechanical studies, it is suitable for toggle rod stabilization because of the polyethylene composition of the suture materials and manufactured suture-button. Furthermore, Ash *et al.* performed toggle rod stabilization with TightRope® and mini TightRope® to correct craniodorsal coxofemoral luxation in cats and small breed dogs. No case of relaxation of the coxofemoral joint in four cats and five dogs was observed (1).

Minimally invasive surgery is common in human medicine. In veterinary medicine, minimally invasive surgery continues to progress, paralleling advances in instrumentation, technology, and increasing familiarity with procedures by newly trained surgeons (6,12). To the best of our knowledge, no previous study has compared open reduction with minimally invasive arthroscopic-assisted reduction with arthroscopy in the hip joint in veterinary medicine. We developed a minimally invasive technique to correct craniodorsal coxofemoral luxation in a dog (5). Furthermore, Hudson *et al.* assessed morbidity in dogs after experimental cranial cruciate ligament transection and immediate stifle stabilization using arthroscopic and open arthrotomy. The results of their study suggested that short-term postoperative morbidity can be reduced in dogs with arthroscopic joint surgery with a limited approach for stifle stabilization as compared with traditional open arthrotomy (6).

Although our report is limited to a single case of a Korean water deer, this case showed a good outcome after toggle rod stabilization with minimally invasive arthroscopic-assisted reduction by craniodorsal coxofemoral luxation. This suggests that the minimally invasive surgical technique described here can be used to correct for coxofemoral luxation in wild animals.

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고라니에서 최소침습적 관절경과 TightRope®의 이용한 엉덩관절탈구 교정 증례

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요 약 : 왼쪽 뒷다리 체중부하 없는 파행을 가진 고라니가 구조 되었다. 임상검사와 방사선검사에서 앞쪽외측 엉덩 관절 탈구로 진단되었고 탈구에 원인은 확인 할 수 없었다. 고나리에 앞쪽외측 엉덩 관절 탈구는 토글 핀(mini-TightRope®)과 관절경을 이용하여 최소 침습적 방법을 통해 교정 하였다. 고라니에 앞쪽외측 엉덩관절 탈구는 수술 후 성공적으로 교정되었다. 수술 후 60일후 고라니는 자연으로 복귀 할 수 있었다. 이번에 사용된 토글핀과 관절경을 이용한 최소 침습적인 엉덩관절 탈구 교정법은 야생동물에서 성공적으로 사용이 가능할 것으로 생각된다.

주요어 : 고라니, 최소 침습적, TightRope®, 엉덩관절탈구, 관절경