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Total Hip Replacement in a Jindo Dog with Dorsal Acetabular Rim Deficiency: a Case Report

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Abstract : A 7-year-old, intact female Jindo dog was presented for assessment of weight-bearing lameness of the right hindlimb. On physical examination, crepitus and pain was noted in the right coxofemoral joint upon extension. Radiographs revealed a craniodorsal luxation of the right coxofemoral joint and degenerative joint disease (DJD) of both coxofemoral joints. Total hip replacement (THR) was performed for the right coxofemoral joint. Intraoperatively, dorsal acetabular rim (DAR) deficiency was noted, which can be related to a high risk for acetabular cup implant dislocation. Deficiency of the dorsal acetabular rim realigned with the acetabular cup using universal locking plate (ULP) and polymethylmethacrylate (PMMA) bone cement. After surgery, the patient had an uneventful course and a successful outcome. The ROM and thigh girth were dramatically improved. There were no complications associated with prosthesis implants. Hip luxation with dorsal acetabular rim deficiency in a dog was successfully repaired with THR and dorsal acetabular rim augmentation using ULP and PMMA bone cement. This technique should be considered when conventional THR is precluded by dorsal acetabular rim deficiency.

Key words **:** total hip replacement, acetabular rim deficits, polymethylmethacrylate bone cement, coxofemoral joint luxation, universal locking plate.

Introduction

Cemented and cementless total hip replacement (THR) procedures are effective treatment options for disabling conditions of the hip joint, such as osteoarthritis secondary to hip dysplasia, failed femoral head and neck osteotomy (FHNO), and irreparable fracture, with success rates of 92% to 97% in veterinary medicine (12,15,18). Complications after THR have been reported in approximately 11% of cases; these include infection, septic and aseptic loosening, fracture of the femur, luxation of the THR joint, and neurapraxia (3,13).

Canine hip dysplasia (CHD) is a congenital disorder which is influenced by a number of factors and forces (6). Surgical treatment of CHD is selected based on patient age and secondary osteoarthritis. THR and FHNO are generally considered to be salvage procedures for CHD with hip laxity and osteoarthritis (2). Choric CHD with secondary osteoarthritis may induce bone change and deficiency on the acetabulum and proximal femur (6). In these cases, it is extremely challenging to treat CHD with THR (10). Although few cases have been reported, in CHD with dorsal acetabular rim deficiency, autogenous bone with a locking plate and PMMA cement are typically used for dorsal acetabular augmentation (10,19).

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This case report describes the surgical technique and outcome of Zurich cementless total hip replacement (ZCTHR) with universal locking plate (ULP) and polymethylmethacrylate (PMMA) bone cement in dorsal acetabular rim deficiency by chronic CHD in a dog.

Case

A 7-year-old, 24.5-kg, intact female Jindo dog was admitted to the Animal Medical Center at Chonbuk National University with right hindlimb lameness. She had been treated with analgesics over 2 months without radiographic examination. On physical and orthopedic examinations, the patient exhibited intermittent weight-bearing lameness of the right hind limb, and pain and crepitus were revealed in the right coxofemoral joint during manipulation. The results of laboratory blood tests were within reference limits. Radiographs of the right pelvis showed proliferative changes in the acetabulum and femoral neck, muscle atrophy of the pelvic musculature, and craniodorsal luxation of the femur head (Fig 1).

Prior to surgery, Premedication was carried out with atropine (0.02 mg/kg SC, Atropine Sulfate Daewon®; Dae Won Pharm, Korea) and butorphanol (0.3 mg/kg IM, Butophan Inj®; Myung Moon Pharm, Korea). General anesthesia was induced with propofol (6 mg/kg IV, Anepol IN®; Ha Na Pharm, Seoul, Korea) and was maintained with isoflurane (Forane soln®, JW pharmaceutical, Korea) delivered in oxygen. Cephalexin (22 mg/kg IV q 2 hours, Methilexin Inj®, Union Korea Pharm,

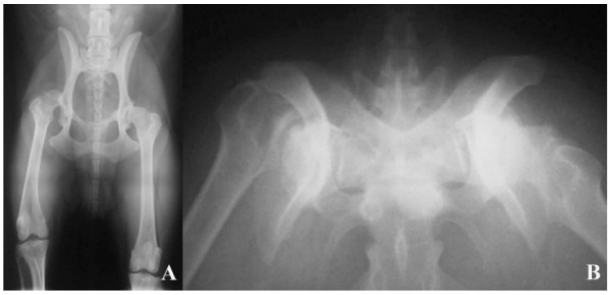

Fig 1. Preoperative ventrodorsal (A) and dorsal acetabular rim (B) radiographs of the pelvis with bony proliferation in the acetabulum and craniodorsal luxation of the femur head.

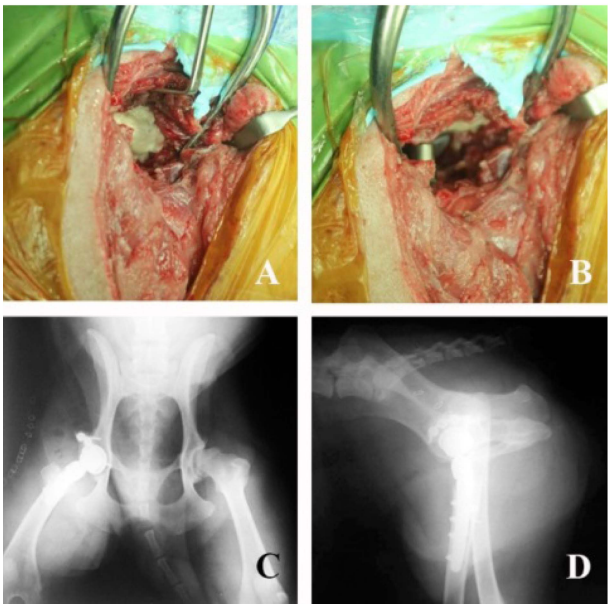

Fig 2. Intraoperative view of the acetabulum. The SOP plate is placed with PMMA cement in the site of deficiency in the dorsal acetabular rim (A). After insertion of the acetabular cup, the PMMA cement is molded with the ULP plate in the site of deficiency of the dorsal acetabular rim (B). Initial postoperative ventrodorsal (C) and lateral (D) radiographs of the pelvis showing that the cup angle of lateral opening is 45° and the angle of inclination is 15°.

Korea) was administered prior to induction of anesthesia. The patient underwent epidural anesthesia with 2% lidocaine (1 ml/4.5 kg, Lidocaine Hcl Dalhan Inj®, Dai Han Pharm, Korea).

The right hip was prepared for aseptic surgery. The patient was positioned laterally with a positioner. ZCTHR was used to implant a 26.5-mm revision acetabular cup and a small stem with a 16-m short head-neck (Kyon Inc, Zurich, Switzerland). All procedures for revision ZCTHR surgery followed the instructions of Kyon Inc., excluding the treatment for acetabular deficiencies (16). After a craniolateral approach, the femur and acetabulum was reamed and broached until appropriate size of the hip prosthesis. Intraoperatively, the dorsal acetabular rim in the left acetabulum was insufficient to seat the acetabular cup. The acetabulum is destroyed and proliferated new tissues. All of the proliferative bony and fibrous tissues covering acetabulum and proximal femur were removed with a high-speed burr and rongeurs. The acetabular cup was impacted in the prepared acetabulum. The 2.7-mm ULP was placed with 2.7-mm cortical screws at deficiencies of the dorsal acetabular rim (Fig 2A). The PMMA cement was molded with the ULP to reinforce deficiencies of the dorsal acetabular rim (Fig 2B). Bicortical screws were inserted in the first and second hole of the stem to enhance for proximal femur. The joint was reduced, and then the tendency of luxation was assessed. The surgical incision was closed in layers.

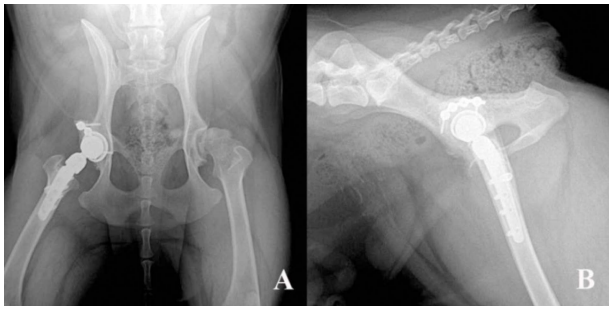

Fig 3. After 4 months, postoperative ventrodorsal (A) and lateral (B) radiographs of the pelvis showing good implant positioning without any changes around the cup or stem.

Postoperative radiographs revealed appropriate implant positioning and orientation (Fig 2C, D.) (9,12). The patient was performed a cast rest and physical therapy for 4 weeks. The patient was discharged from the hospital with carprofen (2.2 mg/kg PO, one daily, Rimadyl®; Pfizer Animal Health, USA) and Cephalexin (15 mg/kg PO, two times daily, Methilexin Inj®, Union Korea Pharm, Korea) for one month.

One month postoperatively, there were no complications associated with THR surgery. The right thigh circumference was 108% compared to the opposite side. Three months postoperatively, the function of the affected limb had improved, and follow-up radiographs at four months did not show any bone reaction or loosening of the prosthesis (Fig 3). The implants were well maintained at 6 months and the dog had a good functional outcome without lameness associated with activity. The owner reported by telephone to exhibit no complications about revision surgery at eight months.

Discussion

THR in chronic CHD is a challenging problem because most chronic CHD causes bone remodeling of the femur head and a shallow acetabulum, in accordance with degenerative joint disease (6). Furthermore, in our case, there was also deficiency in the dorsal acetabular rim (DAR) due to CHD. Thus, we used a cementless acetabular cup with ULP and PMMA cement for implantation of the THR in the acetabu-

lum. In humans, treatment options for acetabular defect after primary THR include a cementless oblong cup, jumbo cup, or roof reinforcement cup with or without allograft bone. There are similarities between the revision acetabular cup and the cementless oblong cup. The cementless oblong cup is indicated for use in less than 50% of acetabular defects. In greater than 50% of acetabular defects, the jumbo cup or the roof reinforcement cup with allograft bone is used (11). Acetabular defects in the dog largely occur in the DAR due to hip dysplasia (20). Pooya *et al*. used the femoral head and neck for acetabular augmentation in 10 canine THRs, and 9 patients had a successful outcome 1 year after THR. However, this technique cannot be used for reimplantation THR after infection (20). An acetabular fracture after cementless THR was successfully treated with the ilial wing and reconstruction plate in a dog. Additional surgical procedures are often required for the treatment of DAR deficiency (21). Fitzpatrick *et al*. reported using the string-of-pearls (SOP) plate and PMMA cement for DAR augmentation in THR in seven dogs with large deficiencies of the DAR, and that there was ideal positioning and no loosening of the prosthesis implants; in addition, all patients clinical signs improved after THR (10). The locking plate and PMMA cement technique used in our case has the advantage of fimbriation of PMMA cement around the SOP plate, and the dispersion of mechanical loads from the acetabular cup. On the other hand, the PMMA cement is continuously demand to observe over long-term follow about aseptic loosening because the PMMA cement will not be incorporated between a host bone.

THR and FHNO can be used for CHD with osteoarthritis in a mature dog (1). Previous reports of the clinical results of FHNO revealed satisfactory outcomes in most cases (4,7). However, these results were based only on veterinarian observations and client questionnaires. Gait analysis after FHNO was documented a shortened time, decreased coxofemoral angle, and increased peak vertical ground reaction force (17). These results demonstrated that the function of the hindlimb is changed after FHNO. Furthermore, it is generally believed that toy or small breed dogs (< 20 kg) have better outcomes than larger breeds after FNHO (4,7). In many cases, there was frequently large breed that have clinical sign with CHD (2,6). THR has been performed for the treatment of the hip joint problems in dogs of any weight (8,12,14,18). Braden *et al*. assessed the utilizing force plate analysis in most dogs with bilateral CHD after THR. This study showed modest objective improvements in vertical ground reaction forces compared to the preoperative limb (5). A previous study reported that the results of unilateral THR surgery, as in our case, demonstrated an acceptable functional improvement in 80% of dogs with bilateral CHD (18).

Although our report was limited to a single case, hip luxation with DAR deficiency was successfully repaired with THR and dorsal acetabular rim augmentation using ULP and PMMA bone cement. This technique should be considered when conventional THR is precluded by dorsal acetabular rim deficiency. Furthermore, ULP and PMMA bone cement in THR can successfully be used to reinforce large acetabular rim deficits.

Acknowledgement

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등쪽 관골절구 결손을 가진 진도견의 인공 대퇴 관절 전치환술

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요 약 : 7년령의 암컷 진도견이 뒷다리 파행을 주증으로 내원하였다. 신체검사상에서 대퇴관절의 신전시 염발음과 통증을 보였고 방사선 검사상에서 양측 대퇴 관절 이형성증에 의한 퇴행성 관절염과 오른쪽 부위의 전측 대퇴 탈구를 보여 주었다. 오른쪽 관절의 탈구의 치료를 위해 인공 대퇴 관절 전치환 술을 실시하였다. 수술 중 오른쪽 등쪽 관절절구의 결손으로 인한 인공 관절절구 컵의 탈구의 위험성을 확인하고 등쪽 관절절구의 결손을 잠김 금속판과 골시멘트를 이용하여 보강하였다. 수술 후 환자는 성공적인 결과를 보여주었다. 또한 오른쪽 대퇴관절의 관절 운동 범위과 근육량이 개선 되었다. 등쪽 관골절구 결손을 가진 대퇴 관절 탈구에서 잠김 금속판과 골시멘트 이용하여 인공 대퇴 관절 전치환술을 성공적으로 실시하였다. 본 증례와 같은 수술 기법이 등쪽 관골절구 결손이 있을 시 사용될 수 있다고 생각된다.

주요어 : 인공 대퇴 관절 전치환술, 관골절구 결손, 골시멘트, 대퇴 관절 탈구, 잠김 금속판