Case Report

J Vet Sci 2015, 16(1), 131-134 · http://dx.doi.org/10.4142/jvs.2015.16.1.131

JVS

Total hip replacement in two dogs with unsuccessful femoral head ostectomy

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An English setter (case 1) and a Tibetan mastiff (case 2) presented with intermittent weight-bearing lameness on the right hind limb when trotting. The dogs had a history of femoral head and neck ostectomy (FHNO). Orthopedic examination revealed pain and crepitus on the right hip joint. The dogs underwent total hip replacement (THR). At the 2-year (case 1) and 1-year (case 2) follow-up, both dogs had resumed normal activity without lameness. The muscle mass and range of motion were significantly improved in the affected hind limb. In conclusion, FHNO with poor functional outcomes can be successfully ameliorated with THR.

Keywords: dog, femoral head and neck ostectomy, lameness, total hip replacement

Femoral head and neck ostectomy (FHNO) is a surgical procedure typically indicated for hip joint problems such as chronic hip dysplasia, luxation, fractures, and avascular necrosis [2,7]. Although the clinical results of FHNO are acceptable, permanent excision arthroplasty that is part of this procedure can result in biomechanical alterations of hip function, including dorsal displacement of the femur, muscle atrophy, restricted range of motion, lameness, and pain during passive movement [6,7]. Total hip replacement (THR) is a surgical technique in which weight-bearing surfaces of the hip joint are replaced with prosthetic implants. THR can improve quality of life by relieving pain and improving joint motion. Due to recent advances in prosthetic implants and technical expertise, THR in veterinary medicine has produced good clinical outcomes [1].

Few studies have reported on failed FHNO that was corrected with THR in dogs and cats. It is extremely difficult to perform THR after FHNO due to the extensive development of fibrous tissue as well as periarticular muscle contracture between the femoral neck and acetabulum that can make reduction of the prosthetic joint very difficult. The risk of postoperative hip luxation also increases after THR. Furthermore, reaming of the femoral canal and acetabular cavity is very challenging due to changes in morphology of the femur and acetabulum associated with bony proliferation. Modified surgical techniques are therefore needed to overcome these problems in specific cases. Anecdotal reports suggest that THR is not recommended when performed more than 6 months after FHNO [4,5]. In this case report, surgical techniques and outcomes of THR in two dogs that had undergone unsuccessful FHNO and subsequent THR at least 1 year later are described.

An 11-year-old, 22 kg intact female English setter (case 1) and a 3-year-old, 53 kg intact male Tibetan mastiff (case 2) presented with intermittent weight-bearing lameness on the right hind limb when trotting. Both dogs had a history of FHNO on the right hind limb. Case 1 had undergone FHNO for a fractured femoral head 2 years before presentation, and case 2 had FHNO to treat an infection after THR 1 year prior to presentation. On physical examination, crepitus and pain were noted in the right hip joint during joint extension. Thigh girth of the right hind limb were 68% (case 1) and 88% (case 2) of the contralateral side. The excursion angle of the right hip joint was 33^{o} (case 1) and 15^{o} (case 2) smaller than that of the left hip joint. Radiographs for both dogs showed extensive remodeling and bony proliferation involving the cut surface of the femoral neck and acetabulum (panels A, E, and F in Fig. 1). Based these findings, each dog was diagnosed with unsuccessful FHNO.

In case 2, dorsal acetabular rim (DAR) bone deficiency was

Received 24 Jan. 2014, Revised 25 Aug. 2014, Accepted 26 Sep. 2014

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pISSN 1229-845X
eISSN 1976-555X

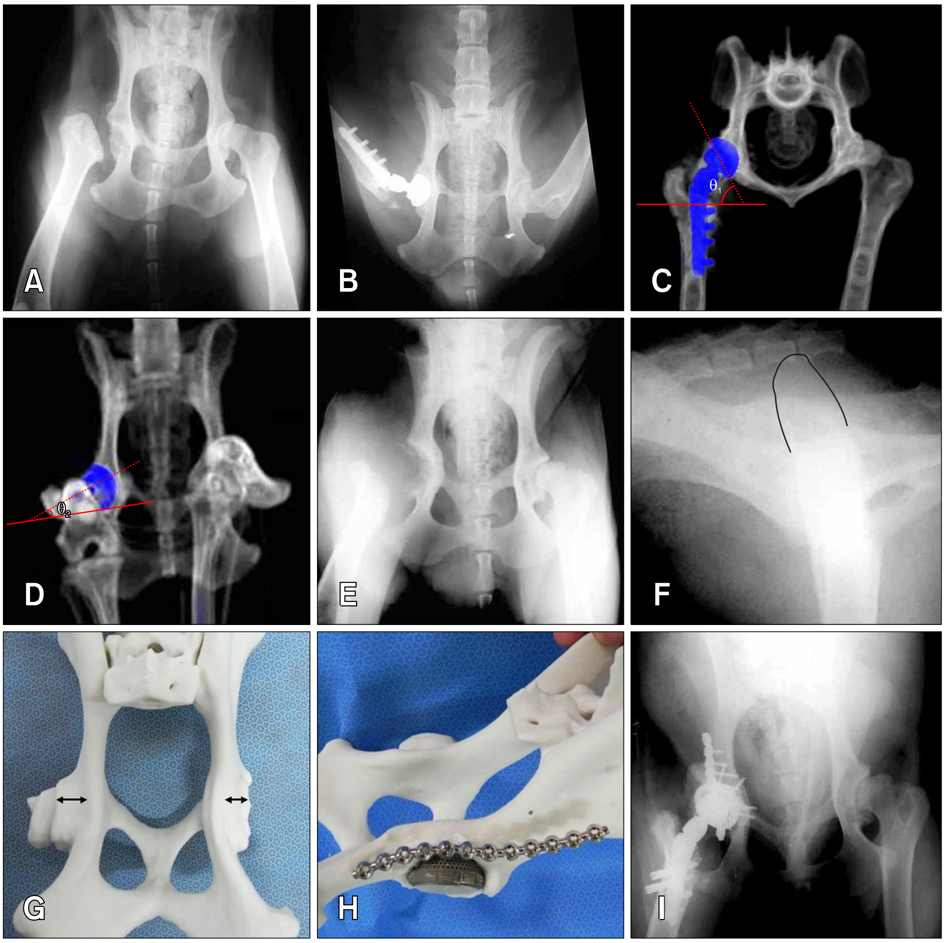

Fig. 1. Preoperative radiographs after femoral head ostectomy performed 2 years prior to the study (A), immediate postoperative frog-legged radiograph (B), and 3-D reconstructed computed tomography (CT) images (C and D) showing that the cup angle of the lateral opening was 60° (θ_1) with a 21° (θ_2) angle of anteversion (case 1). Preoperative ventrodorsal (E) and lateral (F) radiographs of a pelvis with bony proliferation in the acetabulum and dorsal displacement of the proximal femur (dotted line) 1 year after explantation of a primary hip prosthesis. Insufficient dorsal acetabular rim in the right acetabulum (double-headed arrow) of a stereolithographic model (G). Rehearsal surgery was performed on the stereolithographic model (H). Postoperative ventrodorsal radiograph (I) of a pelvis showing appropriate implant positioning, orientation, and reduction (case 2).

noted on x-ray images. For accurate surgical planning, rehearsal surgery was performed on a stereolithographic model (panel H in Fig. 1). DAR augmentation was planned using bone plate and polymethylmethacrylate (PMMA) cement (CMW1; DePuy International, England). The 2.7-mm SOP plate (Orthomed, England) was pre-contoured over the stereolithographic model and sterilized prior to use in surgery. The dogs were premedicated with intramuscular injections of 0.005 mg/kg acepromazine (SEDAJECT Injection; Samu Median, Korea) and 0.4 mg/kg butorphanol (Butophan Injection; Myungmoon Pharm, Korea). In addition, 0.5% bupivacaine (1 mL/5 kg, Pucaine Injection 0.5%; Reyon Pharm, Korea) was administered into the lumbosacral space for epidural anesthesia. After intubation, general anesthesia was maintained with isoflurane (2～3%, Forane; JW Pharmaceutical, Korea) in oxygen (1.5 L/min). The revision surgeries were performed with Kyon implants (KYON Pharma, Switzerland).

Through a craniolateral approach to the hip joint, extensive fibrous tissue was debrided in the hip joint region. Under fluoroscopy (KMC-950; GEMSS Medical, Korea), the femoral canal was identified and a high-speed burr was used to remove the bony proliferation before entering the femoral canal. Femoral canal reaming was completed using increasing size of drill bits or file cutting. The acetabular soft tissue infilling was removed using an acetabulum reamer that was smaller than the final cup size. The final acetabulum reamer size was used to complete the acetabular preparation. For case 1, the cementless acetabular cup was not impacted against the acetabulum due to bone loss on the caudal acetabular margin. A curette was used to make five holes in the exposed cancellous bone from the cranial to the caudal aspects of the acetabulum. The cementless acetabular cup was placed in a bed of PMMA at the cranial and caudal poles. For case 2, the revision acetabular cup was fixed with 2.4-mm cortical bone screws (Orthomed) at the acetabulum. The dorsal acetabular rim around the revision cup was deficient, so cortical screws were used to place the pre-contoured 2.7-mm SOP plate on the dorsal acetabular rim. After insertion of the inner shell of the revision acetabular cup, PMMA cement was molded with the SOP plate to reinforce the dorsal acetabular rim. After femoral stem and cup fixation, reduction of the prosthetic joint was challenging. Pectineal tenotomy and release of the rectus femoris muscle at the origin were performed for reduction of the prosthetic joint. Tissue and blood samples were collected from the surgical site for intraoperative cultures before the surgical wound was closed.

Postoperative radiographs revealed that implant positioning and orientation were appropriate (panels B-D and I in Fig. 1). The dogs recovered with cast rest and physical therapy for 4 weeks. The surgical sites healed without any post-operative complications. Two weeks after discharge, the dogs initiated partial weight-bearing activities without any support or assistance. At 12 weeks postoperatively, thigh girth of the affected limb was 91% (case 1) and 93% (case 2) of the contralateral side. The excursion angle of the right hip joint was 11^{o} (case 1) and 6^{o} (case 2) smaller than that of the left hip joint. At the 2-year (case 1) and 1-year (case 2) follow-up, each dog had resumed normal activities without lameness. Thigh girth of the right hind limb was 116% (case 1) and 98% (case 2) of the contralateral side. No abnormalities of the hip prostheses were found.

In the present study, two dogs that had undergone unsuccessful FHNO were treated with THR. Short-term outcomes included significantly improved range of motion and thigh girth enlargement with no lameness of the affected limb. THR performed after resection arthroplasty is challenging in both humans and animals [4,5,9] due to changes in morphology of the proximal femur and acetabulum after FHNO remodeling. The standard THR surgical technique may need to be modified on a case-by-case basis. Therefore, it is very important to understand changes in morphology of the proximal femur and acetabulum in order to ensure accurate surgical planning and performance. For the present cases, rehearsal surgery was performed on a stereolithographic model. This method helps the surgeon understand changes in femur and acetabulum morphology due to post-FHNO remodeling that may require modifications of the standard surgical procedures. In addition, rehearsal surgery can improve the accuracy and confidence of the surgeon. Case 2 was found to have DAR deficiency during rehearsal surgery, so we performed DAR augmentation with a plate and PMMA cement as a modified surgical technique. The use of a pre-contoured plate may reduce surgery time. The femoral stem should be inserted over the central axis of the femur in the femoral canal. It is therefore critical to know where the central axis of the femur infemoral canal is located during surgery. In our cases, identification of the central axis of the femur in the femoral canal was challenging due to bony proliferation at the region of the femoral neck ostectomy. Thus, fluoroscopy was performed to locate the central axis of the femur. This procedure is useful for identifying anatomic landmarks during surgery.

Previous study has indicated that FHNO has a high success rate of approximately 93% [2]. However, most of these positive results were obtained with subjective methods such as a questionnaire that assessed the owner's satisfaction. In a retrospective study of 132 dogs and 51 cats that had undergone FHNO, 84% of the animals had dorsal displacement of the femur, 75% had muscle atrophy, 74% had a restricted range of motion, and 32% experienced pain during passive movement [7]. These parameters were used to verify that the FHNO limb functioned poorly. Grisneaux *et al*. [6] reported that canine limbs treated with FHNO had significantly lower peak vertical, peak propulsive, and impulse propulsive forces compared to the normal limbs.

THR has been used to successfully treat hip joint problems in veterinary medicine [1]. Studies conducted during the post-THR period have shown that nearly all treated limbs recover normal function [3,4]. Dogan *et al*. [3] assessed kinetic and kinematic gait parameters of dogs after unilateral cemented THR. Results of the gait analysis showed that function of the treated limb regained preoperative values 4 months after surgery. However, no study comparing the outcomes for FHO revision to THR with FHO alone has been performed in the field of veterinary medicine. In human medicine, Rittmeister *et al*. [8] compared the functional results of resection arthroplasty with those of THR after resection arthroplasty. They found that THR after resection arthroplasty is associated with greater patient satisfaction and better hip function than retained resection arthroplasty. Similarly, the range of motion and muscle mass in our study was significantly improved after failed FHO was revised with THR. In conclusion, FHO with poor functional outcomes can be successfully ameliorated with THR.

Acknowledgments

This study was supported by the Basic Science Research Program through the National Research Foundation of Korea Funded by the Ministry of Education, Science and Technology (grant no. NRF-2013R1A1A2009546).

Conflict of Interest

There is no conflict of interest.

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