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Micro Total Hip Replacement in Two Dogs with Legg-Calvé-Perthes Disease

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Abstract : A Maltese (case 1) and a Pomeranian (case 2) presented with acute right and left hind limb weight-bearing lameness. On physical examination, they exhibited severe pain and crepitus on the coxofemoral joint of affected hind limb. In addition, decreased thigh girth measurements were noted compared with the opposite leg. Radiological exam revealed necrotic areas in the femoral head of affected hind limb. These dogs were diagnosed with Legg-Calvé-Perthes disease (LCPD). The dogs underwent micro total hip replacement (THR). After surgery, at 3 years (case 1) and 7 months (case 2), both dogs recovered normal activity. The thigh girth and lameness scores were apparently improved in the affected limbs of both dogs. No complications of prosthesis implants, such as loosening, were noted. The clinical outcomes of these cases indicate that dogs with LCPD can be successfully treated with micro THR and have a good prognosis immediately after surgery.

Key words **:** legg-calvé-perthes disease, femoral head and neck osteotomy, micro total hip replacement, small breed dog.

Introduction

Legg-Calvé-Perthes disease (LCPD) is non-inflammatory aseptic necrosis of the femoral head and occurs in young patients prior to femoral closure (16). Small breed dogs, such as Yorkshire Terrier and Dachshund (6-7 months, < 10 kg), are diagnosed at a young age (26). The blood supply to the femoral head of a young animal is reduced due to factors, such as hormone effects, genetic, anatomical structural anomalies and joint space pressure, causing ischemic necrosis from the femoral head. The repetitive forces that are applied to the bone during growth cause segmentation and collapse of the head of the femur. In general, the flattening of the femoral head progresses. Then, discordance occurs between the acetabulum and the head of the femur, causing degenerative joint disease and resulting in pain and lameness. During physical examination, this pain is evident when the hips are manipulated. As the disease progresses, the range of motion is reduced, muscles are contracted, and crepitus occurs. Radiographically, the femoral head deformity and decreased bone density within the epiphysis of the femur are also observed (9,16,27).

Conservative treatment includes restraint of exercise, use of anti-inflammatory drugs, and rehabilitation, such as swimming. This treatment to alleviate pain has been reported to be effective only in 25% of affected patients. On the other hand, surgical treatments have a good prognosis. Therefore, surgical treatment, such as femoral head and neck osteotomy (FHNO) or total hip replacement (THR), is been preferred (6,7,10,18,29).

Among salvage procedures, femoral head and neck osteotomy (FHNO) is a widely used method regardless of dog size. Simple surgical procedures and a satisfactory prognosis for the owner are the advantages of this procedure (2). However, given that the legs cannot be used immediately after surgery, the legs must be moved manually similar to that in rehabilitation. In addition, pain reduction is not clear compared with before surgery, and a pain reliever is also needed to promote early functional recovery (14,19,24).

However, because total hip replacement (THR) can immediately reduce pain and improve joint motion after surgery, THR is recently commonly used and widely accepted as a surgical treatment for painful, irreversible, developmental, or acquired conditions of the coxofemoral joint in large breed dogs (1). The goal of total hip arthroplasty is to return a chronically lame dog that is nonresponsive to medical treatment to near normal or normal function, i.e., athletic, sporting, and working-breed dogs (15,17). THR systems were originally restricted to medium to large breed dogs. However, with the recent introduction of the miniature and micro THR system (BioMedtrix Inc., Boonton, NJ), small breed dogs became THR candidates (25). Recently, Micro-THRs have actively been used in small breeds that are likely to have hereditary diseases, such as LCPD (20,21,22).

The purpose of this case report is to describe the successful postoperative outcome of two micro THR patients with LCPD. The outcome is determined by radiographic images, owner satisfaction, physical examination, and gait evaluation.

Case

Case 1

A 1-year-old, 4 kg castrated male Maltese dog was referred with right hind limb lameness. The degree of lameness was scored based on the standard lameness scale used at Tufts University School of Veterinary Medicine: 0 = no percepti-

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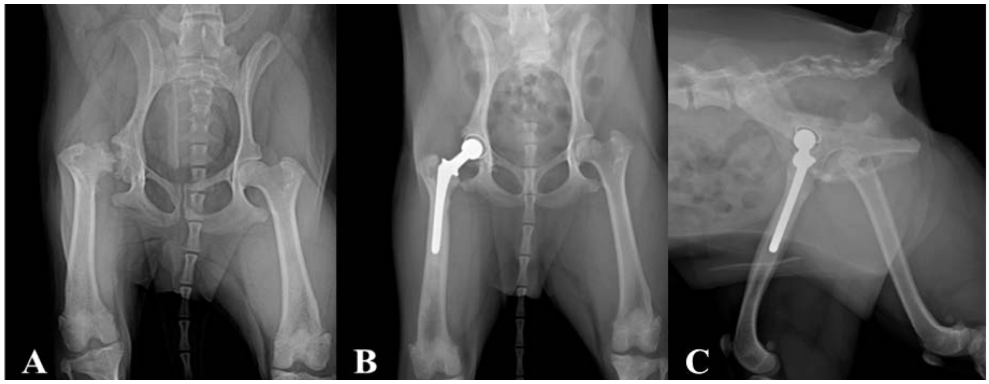

Fig 1. Radiographic images of micro THR in case 1. Preoperative radiograph revealed flattening and mottling of the femoral head and collapse and thickening of the femoral neck in the right hind limb (A). Postoperative images after 5 weeks revealed right positioning without significant alterations around implants (B, C).

ble lameness; 1 = weight bearing with an occasional lameness; 2 = weight bearing with frequent but intermittent lameness; 3 = continuous weight bearing lameness; 4 = weight bearing lameness with occasional nonweight bearing lameness; 5 = nonweight bearing lameness. On physical examination, severe pain and crepitus were noted on the right hip joint during joint extension. Thigh circumference was 79% of the contralateral limb. On radiological examination, the right femoral head and neck exhibited flattening and mottling of the femoral head, collapse and thickening of the femoral neck.

Cemented micro THR (BioMedtrix Inc., Boonton, NJ) for the right hip joint was performed. The patient was premedicated with atropine (0.03 mg/kg SC, Atropine Sulfate Daewon®; Dae Won Pharm, Korea), Cefazolin (22 mg/kg IV, Cefazolin®; Jong-keundang, Korea), and tramadol (5 mg/kg IV, Maritrol; Jeil Pharm, Korea), butorphanol (0.3 mg/kg, IV, Butorphan INJ; Daewoo Pharm, Korea). Anesthesia was induced with propofol (6 mg/kg, IV, Anepol IN®; Ha Na Pharm, Korea). Anesthesia was maintained using isoflurane (Forane soln®; JW pharmaceutical, Korea), and epidural anesthesia was performed with 0.9 ml of 2% lidocaine (1 ml/4.5 kg, Lidocaine Hcl Dalhan Inj®; Dai Han Pharm, Korea). A skin incision was made on the lateral aspect of the thigh to approach the hip joint. The patient was positioned in lateral recumbency and stabilized with positioning tethers and vacuum beanbag positioners. Care was taken to have direct superimposition of both coxofemoral joints. The femoral head was removed using a bone saw. The proximal aspect of the femoral canal was opened, and the bone marrow was reamed for insertion of the femoral stem. Acetabulum was power reamed using acetabular reamers selected based on preoperative measurements. Articular cartilage at the osteochondral junction of the acetabular rim was removed using a high-speed burr. Four or Five holes were created from the craniodorsal to the caudodorsal aspects of the acetabulum into cancellous bone for cement intrusion using a burr. If present, osteophytes are removed, and acetabular components are positioned anatomically. An appropriate femoral neck length on the femoral head was applied. The acetabular cup was implanted in the bed with the cranial and caudal poles. The acetabular component was implanted first, and the femoral stem implanted after the acetabular bed cement hardened. The prosthetic implants, acetabular cup and femoral stem were inserted at each position. A prosthetic femoral head was connected to the femoral stem and was reduced into the acetabular cup. Before closing, a bacterial culture was performed. The postoperative cup angle of lateral opening was 39 degrees, the cup angle of retroversion was 44 degrees, and the inclination was 22 degrees. Postoperative radiographs revealed appropriate implant positioning and orientation (Fig 1).

Daily physical rehabilitation, including cold therapy, warm compresses, and controlled exercises, were administered. On the first two days, a cold pack was applied. During the following five days, a hot pack was applied at the postoperative site. The patient was restricted to cage rest 10 days after surgery with instructions to limit activity to surfaces with good traction when indoors and to prevent challenging activities. Leash restraint was performed for 5 weeks after surgery when outdoors. Five weeks after surgery, the thigh girth of the affected hind limb was 98% of the contralateral side. In addition, the lameness score was 0 (Table 1). Radiographs exhibited good congruity between the femoral head and the acetabular cup. Complications, including implant luxation or loosening, were not detected. In addition, patient activity increased.

Case 2

A 2-year-old spayed female Pomeranian dog presented

Table 1. Clinical evaluation before and after THR

Assessment	Preoperation Thigh girth	Postoperation Thigh girth	Preoperation Lameness score	Postoperation Lameness score
Case 1	79%	98%	2	0
Case 2	86%	98%	3	0

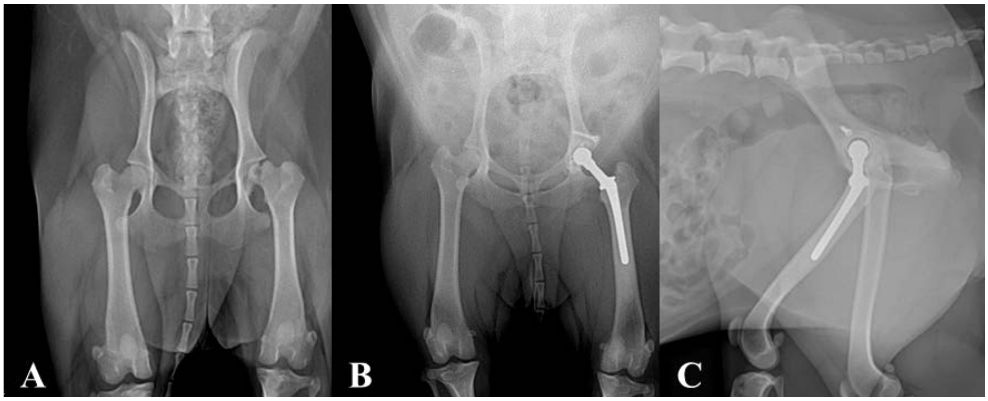

Fig. 2. Radiographic images of micro THR in case 2. Preoperative radiographs revealed widening and flattening of the femoral and bone remodeling (A). Seven months after THR surgery, the image revealed proper implant alignment and device fixation without aseptic loosening (B, C).

with left pelvic limb lameness. Physical examination, gait evaluation, blood tests, and radiography were performed. On physical and gait examination, she exhibited severe pain on the left hip joint during joint extension and intermittent lameness. Thigh girth was measured, and the affected leg was 86% of the normal leg's thickness. Radiographically, the left coxofemoral joint space was widened. In addition, the head of the left femur was flat, and cortical bone destruction and clear osteolysis were noted. After diagnosis with LCPD, micro THR surgery was planned. The patient was premedicated with cefazolin (22 mg/kg IV, Cefazolin®; Jong-keundang, Korea), midazolam (0.2 mg/kg IV, Midazolam®; Bukwang, Korea), hydromorphone (0.1 mg/kg IV, Dilid®; Hana, Korea), and Maropitant (1 mg/kg SC, Cerenia™; Zoetis, Korea). Anesthesia was induced with propofol (4 mg/kg IV, Provive®; Myungmoon, Korea). Respiratory anesthesia was maintained with Isoflurane (Ifran®; Hana Pharm, Korea), and epidural anesthesia was also performed with morphine (0.1 mg/kg, morphine sulfate injection BC; BCWP Pharm, Korea).

The patient was positioned with the hemipelvis superimposed in the sagittal plane and held using a vacuum beanbag. First, the femoral head was aligned with the guide stem and removed with a bone saw. A rongeur and a drill bit are used to trim the area around the external rotator tendon to open the femoral canal. Then, the femoral bone marrow was prepared using an awl and a reamer. Implant size and anatomic alignment were again confirmed and determined through trial femoral implants. The acetabulum was reamed using acetabular reamers selected based on preoperative measurements. The surrounding cartilage and osteophyte were removed using a rongeur and high-speed burr. To enhance the bone-cement bonds, channels were created near the back of the acetabular wall. Hemostasis and lavage were performed thoroughly. Bone cement was placed during the liquid phase. The acetabular cup and femur stem were placed and adjusted according to the THR guide (21). Rearticulation of the femoral head prosthesis into the acetabulum was successfully implemented. Then, a bacterial culture was performed, and the surgical site was closed.

The postoperative cup angle of the lateral opening was 36 degrees, the cup angle of retroversion was 27 degrees, and the inclination was 22 degrees.

During the first 3 days, cold therapy was performed followed by passive range of motion (PROM) with warm compression. In addition, exercise was limited. The patient was restrained by cage rest for more than 10 days after surgery. Five weeks after the operation, outdoor activity was resumed via leash walking. No differences between the two hemipelvic muscles were noted at 7 months postoperatively. Regarding thigh girth measured 7 months after surgery, the operated leg was 98% of the normal leg (Table 1). The left implant alignment and device fixation did not change significantly compared with immediately after surgery (Fig 2).

Discussion

All dogs with Legg-Calvé-Perthes disease (LCPD) treated with micro THR exhibited good prognosis in thigh muscle thickness and walking assessment.

LCPD is prevalent in small breeds and occurs at younger ages. Patients generally worsen over 6-8 weeks, and weight bearing lameness progresses slowly. Given that young patients can improve as they grow in many cases, surgery should be used with caution in young animals. Surgery is selected when conservative treatment does not improve and methods other than surgery are not possible (5,9).

Among the various surgical procedures, FHNO forms a fibrous false joint and restricts bone contact between the femoral head and the acetabulum. Most patients with painful hip arthritis have improved leg function and quality of life after receiving femoral head and neck resection (13). Although most miniature dogs have satisfactory outcomes with femoral head and neck ostectomy, these results were noted only with veterinarian observations and client questionnaires. After FHNO, gait analysis reveals that it is not completely normal (3,24). In addition, these conditions can cause unexpected pain with a difference in hind limb length because they significantly modify biomechanical function (10,11). A retrospective study on 132 dogs that received FHNO revealed that 84% experienced femur dorsal displacement, 75% muscle atrophy, and 74% decreased range of motion (24). These

results demonstrated that the function of the hindlimb is altered after FHNO. Because fibrous false joints after FHNO are unstable, it is difficult for patients to recover clinical function after surgery.

THR surgery is also selected when the function of the leg and the quality of life of the patient can no longer be maintained by medical treatment. Unlike FHNO, the positive aspects of micro THR include its ability to maintain normal joint function (15). After THR surgery, a report demonstrated that both legs recovered normal function in kinetic and kinematic gait evaluations (4). In addition, micro THR does not require long-term postoperative rehabilitation and use of analgesic painkillers. After surgery, patients immediately exhibited good gait without severe lameness, and the owner is satisfied (15).

All of these cases were also able to walk immediately after the surgery day, and the muscle mass of the affected legs gradually improved over time. When the thigh girth of each patient was measured, no differences were noted over time. However, this study has the disadvantage of no force plate gait analysis.

However, THR also has disadvantages. The cost is high, and postoperative complications are noted. The most common postoperative complications include hip luxation, femur fractures, aseptic loosening of the acetabulae-acetabular cup and/or femoral stem, patellar luxation infection, pulmonary embolism, and incision granuloma medullary infarction (5,15). In particular, younger patients have higher bone metabolism and faster and safer bone growth. In addition, given the long life expectancy, complications may occur in which the implant-cup position loosens aseptically after cement THR as a result of activity. Therefore, cementless implants have been reported to be more appropriate for younger patients (5,17). However, 3 years after surgery (case 1) and 6 months after surgery (case 2), no aseptic loosening of the implant after cement use was noted.

In our patients, the micro THR produced satisfactory postoperative results, and no associated side effects were observed.

Conclusion

This case report revealed promising post-surgical outcome of micro THR in small breed dogs with Legg-Calvé-Perthes disease. Although there is a disadvantage of high cost and careful postoperative care, it is necessary to consider micro THR in LCPD patients.

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