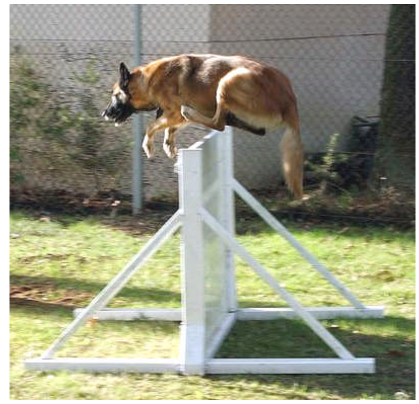
Canine Hip Dysplasia: Surgical Treatment for the Military Working Dog



CPT Kent J. Vince, VC, USA

Hip dysplasia is one of the most common orthopedic diseases in dogs. All breeds of dogs can be affected by this developmental disease. However, it mainly affects medium and large breed dogs such as the German Shepherd Dog. Pain and decreased hind limb mobility and function are the end result of this complex disease process. Severe canine hip dysplasia (CHD) can be career-ending for the Military Working Dog (MWD).

The German Shepherd Dog and Belgian Malinois make up the overwhelming majority of MWDs in America. Their high energy, trainability, intelligence, physical stature, and ideal personalities make them excellent working dogs. Unfortunately, these large breeds are often afflicted with orthopedic developmental diseases such as hip and elbow dysplasia. The Department of Defense Military Working Dog Center (DoDMWD) performs a variety of screening tests prior to the purchase of potential MWDs. Over 60% of all dogs evaluated are rejected because of behavioral or medical problems.[1] As one part of the screening process, radiographs of the pelvis are performed to look for signs of hip dysplasia. Dogs with signs of hip laxity or degenerative joint disease based on these radiographs or physical exam are rejected from purchase.

Several retrospective studies have evaluated the cause for retirement or euthanasia of the MWD. From 1993 to 1996, 19.5% (178/927) of all MWD removals from service were due to appendicular degenerative joint disease (DJD), primarily hip and elbow dysplasia.[2] From 2000 through 2004, that figure improved to 8.2% (22/268).[3] Several conclusions can be drawn from these figures:

1. Medical management of DJD has improved significantly to keep the MWD working longer.
2. More stringent physical exam and radiographic screening tests are performed prior to purchase, thus the DoDMWD purchases fewer dogs with developmental problems.
3. Breeders are culling undesirable developmental conditions from their breeding programs, thus producing a healthier dog for sale.

In any case, the fact that fewer MWDs are forced into retirement due to canine hip dysplasia is in the best interest of the DoD.

DIAGNOSIS

The diagnosis of CHD is based on history, clinical signs, physical examination findings, and radiographs of the coxofemoral joint(s). Hip dysplasia often clinically presents in a biphasic process. Lameness develops initially at 3 to 10 months of age during the early phase of the disease. This pain is due to subluxation, inflammation, and synovitis induced from the hip joint laxity. Most young dogs suffering from CHD will "grow out" of their lameness close to a year of age. The pain usually returns during midlife of the dog, starting around 4 to 5 years of age. This second phase of pain is again associated with inflammation and synovitis, but in addition, the coxofemoral joint has undergone erosive cartilage changes, thickening of the joint capsule, osteophyte formation, and bony remodeling changes. The exhibited lameness can range from very mild only after strenuous activity, to very severe, such as the inability to bear significant weight or walk on the affected pelvic limb. Some owners report a "bunny hopping" run as the dog limits its coxofemoral joint range of motion to prevent exacerbation of the pain.

Physical exam findings most often elicit pain of the hip region during extension, external rotation, and

Figure 1. A ventrodorsal extended pelvic view radiograph from a 2-year-old dog without any evidence of degenerative joint disease or canine hip dysplasia.

abduction of the coxofemoral joint. Some dogs will become fearful and potentially aggressive when the examiner attempts to palpate or manipulate the hip joint. Crepitus is usually felt during the later phase of the disease as the joint has undergone significant degenerative changes. Subluxation can be felt in many young dogs. A low "clunk" is usually felt or heard during the abduction of the coxofemoral joint in young dogs as a result of the reduction of the subluxated femoral head. This clunk is referred to as an Ortolani sign and is highly suggestive for hip joint laxity. Muscle atrophy of the thigh is commonly seen in cases of CHD, but most obvious when only one leg is affected.

Several radiographic techniques have been described to screen for signs of canine hip dysplasia. The PennHIP* distraction radiograph technique, the dorsal acetabular rim view, and the ventrodorsal pelvic view are all routinely performed. However, the most commonly performed radiograph is the ventrodorsal pelvic extended view (Figure 1, Figure 2) for diagnosis of CHD. The radiographic changes seen with canine hip dysplasia can include subluxation of the femoral head; flattening of the femoral head; osteophytosis of the femoral head, neck, or acetabulum; sclerosis of the femoral neck; and evidence of the insertion of the joint capsule on the femoral neck.

*University of Pennsylvania Hip Improvement Program

CONSERVATIVE TREATMENT

The goal of standard conservative management of CHD is the alleviation of hip pain. The pillars of conservative management include exercise modification, weight management and diet, pain relieving drugs, and chrondroprotective agents. Adequate exercise is important for maintaining and improving muscle mass and function. This can be achieved through daily leash walk activity, moderate running, and veterinary physical rehabilitation exercises, including the use of treadmills or underwater treadmills. Disuse atrophy can often be remedied with the addition of an appropriate exercise program.

Weight management and dietary intake are two of the most important external contributing factors in CHD. It is well known that overweight or obese dogs are

Figure 2. A ventrodorsal extended pelvic view radiograph of a 6-year-old female German Shepherd Dog with severe degenerative joint disease from canine hip dysplasia.

often less active than normal weight dogs and the added weight puts significant strain on ligaments and joints. A lifelong study evaluated the affect of a restricted diet on the onset of radiographic evidence of hip osteoarthritis in dogs. The median age for onset of radiographic signs of osteoarthritis in dogs fed ad libitum was 6 years versus 12 years for dogs fed a 25% reduced diet. The investigators concluded that dietary restriction by 25% resulted in significant delay of the onset of radiographic signs of hip arthritis.[4]

Pain relieving drugs are an important weapon in the treatment of CHD. A multimodal approach to treating the pain of hip dysplasia has been used with a variety of classes of drugs. Nonsteroidal anti-inflammatories (NSAID), such as carprofen, deracoxib, meloxicam, and tepoxalin, are usually the first line of defense. They work well at reducing the inflammation within the joint which reduces the sensitivity of the nerves and results in decreased pain. Extensive research has been performed and determined that several of these NSAIDs can be safely used for long-term therapy. Tramadol is a synthetic opioid that has great benefit in relieving pain in dogs. Amantadine is an NMDA antagonist that can be used in the treatment of chronic pain. In addition, gabapentin, an antiepileptic drug, has been successfully used to treat presumed pain in dogs. A combination of an NSAID and these additional drugs can be useful in alleviating the pain induced by CHD.

Chondroprotective agents have become quite popular in the treatment of arthritic disease in dogs. These drugs aim to protect and provide the building blocks of cartilage and synovial fluid to help promote the ideal joint health. There are several glucosamine containing veterinary products available including Cosequin®, GLC 5500, and Glyco-Flex®, all aimed at promoting joint health. Adequan® is an injectable polysulfated glycosaminoglycan that helps prevent the breakdown of joint cartilage. Veterinary research showing significant improvement in dogs suffering from CHD with the administration of these chrondroprotective agents is limited. Because some dogs appear to improve clinically, many clinicians advocate a trial to see if they help a specific individual.

Surgical Treatment

The primary goals of surgical treatment for CHD are alleviation of hip pain and return to normal function of the affected leg. Surgery is often used in conjunction with medical management. Total hip replacement (THR) and femoral head ostectomy are the 2 primary surgical options for treatment of hip dysplasia. Surgery is usually performed when medical and conservative management of the disease is no longer successful.

Femoral head ostectomy is typically thought of as a last resort salvage procedure in dogs suffering from severe hip dysplasia. In this surgery, the femoral head and portions of the neck are cut and removed thus eliminating the bone on bone contact of the coxofemoral joint. The muscles and soft tissues surrounding the proximal femur and acetabulum will form a "false" joint. The long-term return to function of the affected leg is variable and often dependent on several factors including the size and body condition of the dog. While dogs undergoing femoral head ostectomy will not have 100% normal function of the affected leg, nearly 90% of owners reported a good outcome with this procedure.[5]

Canine total hip replacement is the best surgical option for returning an affected coxofemoral joint to normal function. THR has been performed in both a research and commercial setting in canine patients for several decades. Initial metal implants were fixed with bone cement into the femur and acetabulum. This technology has gone under several improvements and advancements over the past 30 years and is still used today in both dogs and humans. Newer technology has led to the development of uncemented implants. Porous-coated implants are press fitted into the proximal femur and acetabulum. The bone grows into the porous coating, permanently stabilizing the implant in approximately 2 to 4 weeks. A long-term study evaluating the use of uncemented porous-coated THR implants in dogs revealed an 87% success rate. The authors concluded that after a 6-year follow up, uncemented fixation of femoral stem and acetabular cup implants was successful.[6]

At the North Carolina State University Veterinary Teaching Hospital, the implant of choice is the BFX™ (biological fixation) total hip replacement system by BioMedtrix (Boonton, New Jersey). This system uses a cobalt chrome femoral stem with 3 layers of micro beads surrounding the proximal third of the implant (Figure 3). The femoral head component is a highly polished cobalt chrome sphere that is lightly hammered onto the femoral stem component. The acetabular cup component has an outer shell made of titanium with 3 layers of micro beads and an ultrahigh molecular weight polyethylene liner (Figure 4). The layers of micro beads create a porous coating on the implants that allow for bony ingrowth and when healed, a very stable implant-bone interface. In human total hip replacements, the implants are expected to last greater than 20 years. Thus, the BFX total hip replacement implants are expected to last the lifetime of the dog.

Figure 3. The BFX femoral stem implant

Proper patient selection and surgical planning are imperative for surgical success. The patient must be free of any systemic diseases or infections that could potentially spread to the implants, as implant associated infection would result in failure. The patient must be well-trained and sensible so as to tolerate small cage/kennel confinement and controlled activity during recovery. Any excessive activity too early in the postoperative recovery phase could lead to implant movement, or, even worse, implant associated bone fracture or luxation. While there are a variety of implant sizes to accommodate most medium and large breed dogs, the patient must be of appropriate size to ensure proper implant fit. Preoperative radiographs are used to estimate the size of femoral and acetabular implant and to give the surgeon an idea of how much bone to remove during the preparation of the bone bed. The patient should be free of any neurological conditions that might affect the use of the hind limbs such as lumbosacral disease. The patient should also be free of any other orthopedic disease affecting either one of the pelvic limbs, such as cranial cruciate ligament rupture.

The surgical procedure for canine total hip replacement is technically challenging and should only be performed by a highly qualified veterinary surgeon. During the procedure, the anesthetized patient is placed in a pelvic positioning device to aid in appropriate implant alignment. Strict aseptic technique, perioperative antibiotics, and surgeon sterility are vital in preventing surgical associated infection. A craniolateral surgical approach is made to the coxofemoral joint. The head of the femur is precisely cut to expose the femoral canal and also to provide increased exposure to the acetabulum. The acetabulum is sequentially reamed and shaped to accurately prepare the bone bed for the implant. Once the bone bed is prepared to the proper size, the porous-coated titanium acetabular implant is seated and hammered into position and correct orientation. The femoral canal is then drilled and shaped with a series of graduated broaches to prepare the femoral bone bed. Once the appropriate canal preparation is attained, the femoral stem is impacted into the proximal femoral canal. A trial size femoral head is then placed on the femoral stem to determine the appropriate femoral head implant. Different femoral heads allow the surgeon to lengthen or shorten the femoral neck, thus helping to minimize the possibility of postoperative coxofemoral luxation. Once the appropriately sized head has been placed, the femur is reduced and the joint capsule is closed. The muscles, soft tissues, and skin are closed in a routine manner and an adhesive bandage is applied over the surgical incision. Postoperative radiographs are made to ensure appropriate orientation and alignment of the implants.

Figure 4. The BFX acetabular cup implant

The postoperative recovery period is imperative to surgical success of the total hip replacement procedure. All dogs are administered at least 2 types of drugs to aid in pain relief during the first 2 to 4 weeks of recovery. Most dogs are toe-touching lame the day after surgery. The patient will often bear significant weight on the affected limb the second day after surgery. Owners are instructed to use a sling placed under the dog's abdomen to help prevent a fall while the dog is walking and to help control the patient if they try to be too active. The dog is strictly confined and only allowed to go outside on leash for bathroom use for the first 4 weeks. During the second month, short 5-minute leash walks are performed twice daily and gradually increased to 30 minutes by the end of the month. During the third month, the leash walk activity is continued and a small amount of supervised off-leash running is permitted. Postoperative recheck examinations are performed at 3, 6, and 12 months. Radiographs are made to evaluate the implants for any signs of movement, bone reaction, or possible infection. If no problems are detected on physical exam or radiographs at 3 months, the dog is permitted to return to normal activity and training.

While the complication rate with the BFX total hip replacement system is low, the complications can be significant. Postoperative coxofemoral luxation, femur or pelvic fracture, implant subsidence or movement, and implant infection are all possible THR complications. Coxofemoral luxation is usually treated with reoperation and the placement of an iliofemoral suture to help prevent craniodorsal luxation. Femur or pelvic fractures are usually treated with reoperation and internal fixation with a bone plate and screws. Depending on the degree and severity of the implant movement or subsidence, surgery may not be indicated. In extreme cases of implant movement, reoperation is usually performed, and either a larger implant is placed or a cemented implant is used. In the very rare case that an implant associated infection develops, bacterial culture is performed and antibiotic therapy instituted. If the infection fails to resolve, the implants usually must be surgically removed.

CASE REPORT: MWD BENNY

At the time of original presentation to the North Carolina State University Veterinary Teaching Hospital (NCSU VTH), MWD Benny was a 5-year-old, male, German Shepherd Dog certified in patrol and explosives detection stationed at Marine Corps Air Station, Beaufort. He had a 3-month history of right hind limb lameness during training and working. He had been previously treated by the attending Veterinary Corps Officer at the Marine Corps Recruit Depot, Parris Island, with carprofen (Rimadyl®) 100mg orally every 12 hours, Cosequin 2 tablets twice daily, and exercise restriction. His physical exam findings at the NCSU VTH included mild lameness of the right hind leg while walking, pain on extension of the right coxofemoral joint, slight pain on extension of the left coxofemoral joint, positive Ortolani sign of the right coxofemoral joint, and mild right hind leg muscle atrophy when compared to the left hind leg. Complete blood count and blood serum chemistry indicated elevated cholesterol (454mg/dL ref. range 92-324) with all other values within normal limits. Radiographs performed at NCSU VTH revealed pronounced left coxofemoral DJD with osteochondral fragments, bilateral mild coxofemoral subluxation, and mild right femoral head remodeling (Figure 5). On the basis of physical exam and radiographic findings, the diagnosis of coxofemoral DJD and hip dysplasia was made. Since MWD Benny's lameness and pain response were more severe on the right hind leg, a total hip

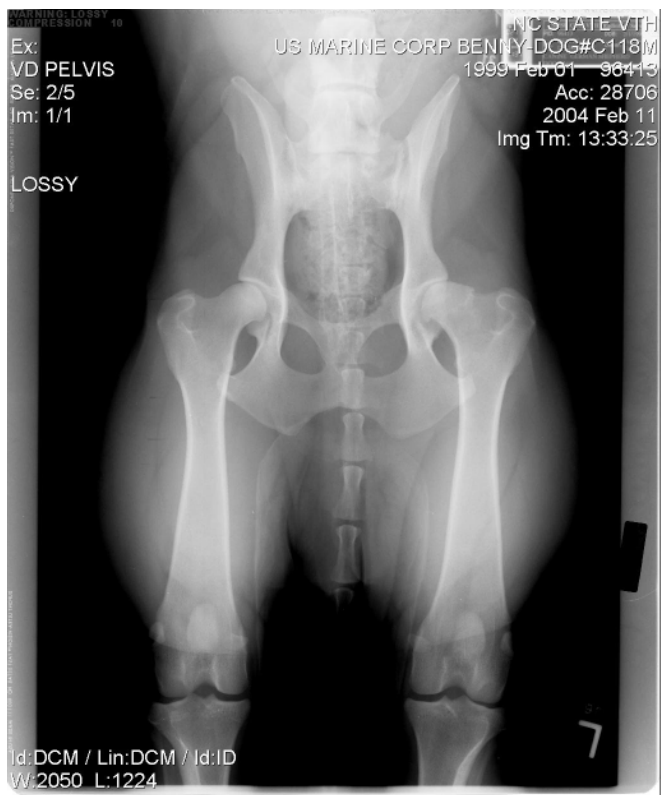


Figure 5. Preoperative ventrodorsal extended pelvic view of MWD Benny. Despite the moderate degenerative joint disease changes in head of the left femur, there is radiographic evidence of disuse muscle mass atrophy in the right leg compared to the left.

replacement was performed only on the right coxofemoral joint.

A BFX modular total hip replacement system was used in MWD Benny. His ideal temperament, outstanding drive, and excellent detection abilities made him the ideal patient. The anesthetized patient was placed in a pelvic positioning device on the surgery table to ensure appropriate alignment. A modified craniolateral approach to the right coxofemoral joint was made. The femur was externally rotated, the round ligament was cut, and the femur luxated to expose the femoral head. The neck cutting guide was positioned and a femoral neck cut was made at the level of the lesser trochanter with an oscillating bone saw. The femoral head was removed. With the acetabular cup exposed, a set of sequentially sized reaming devices were used until the medial acetabular cortex was identified. A 26mm BFX acetabular cup was placed and seated within the right acetabulum. The femur was then elevated and the caudal and lateral femoral neck was removed with rongeurs. The femoral canal was opened with a 5mm drill bit and then sequentienally enlarged with #6, #7, #8, and #9 broaches. A #9 BFX femoral stem was impacted and firmly seated in the right femur. A +3 femoral head was lightly hammered onto the femoral neck. The joint was reduced and the limb could externally rotate 90º without luxation. The joint capsule, muscles, subcutaneous tissues, and skin were closed in a routine manner. Postoperative radiographs were taken to assess implant placement and positioning. The patient recovered from anesthesia without complications. Hydromorphone and medetomidine were administered postoperative for 24 hours as needed for pain relief.

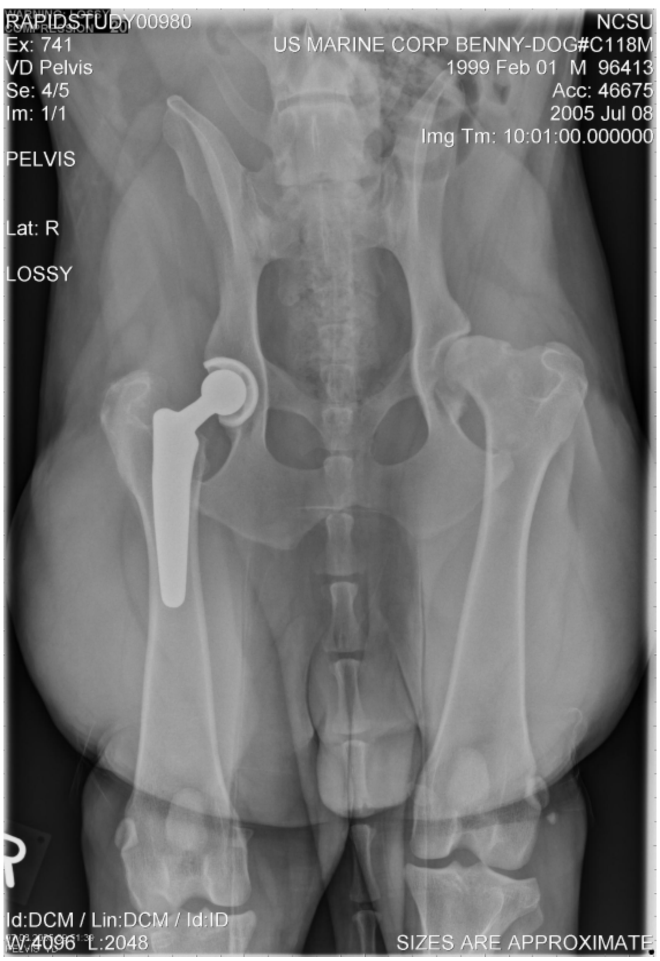


Figure 6. Ventrodorsal extended pelvic view of MWD Benny at 17 months postoperative

MWD Benny was discharged approximately 48 hours after surgery. Carprofen 75mg orally every 12 hours and Cosequin 2 tablets twice daily were prescribed. Strict kennel confinement and activity restriction was mandated for 4 weeks. During the second month of recovery, MWD Benny's activity included leash walks 2 to 3 times a day, starting at 5 minutes and increasing progressively to 30 minutes by the end of the month. During the third month, activity continued to increase to allow for short periods of off-leash running on a daily basis and continually working up to resume a near normal presurgery level of exercise.

At the recheck examination 3 months postoperative, MWD Benny was using the right leg with no observed lameness in either limb. There was no pain on palpation or manipulation of the right pelvic limb with range of motion within normal limits. There was mild muscle atrophy of the right hind leg compared to the left. Radiographs did not detect any significant change in the implants or the bone from the radiographs taken immediately after surgery. MWD Benny was authorized to return to full activity.

At the 6-month recheck examination, MWD Benny had returned to normal training (obstacle course) and activity (patrol/attack work) without any lameness or problems noted by the handler. There was no lameness or pain detected in the pelvic limbs on physical exam. Current radiographs did not detect any significant change from the radiographs taken immediately after surgery.

MWD Benny returned to the NCSU VTH 17 months postoperative for a recheck examination. He had just returned from an 8-month deployment to Iraq and performed without complications during his tour of duty. Physical exam again did not detect any abnormalities, lameness, or pain in either pelvic limb. Radiographs did not detect any changes from the radiographs made 11 months earlier (Figure 6). DJD of the left coxofemoral joint was still present but unchanged from earlier radiographs.

MWD Benny made a total of 3 deployments to Iraq after his total hip replacement in February 2004. He has not developed any clinical lameness affecting his right hind leg associated with the total hip replacement. Unfortunately, MWD Benny developed significant lameness of his left pelvic limb due to the progression of degenerative joint disease and hip dysplasia during his third deployment and returned home early.

Conclusions

Total hip replacement for the treatment of canine hip dysplasia is highly successful at alleviating pain and returning the affected limb to normal function. Canine hip dysplasia has been the most common medical cause of early retirement for MWDs. The BFX uncemented total hip replacement provides a pain free normal functioning coxofemoral joint in the dog. In special cases of well-mannered, highly skilled, and technically proficient MWDs afflicted with severe canine hip dysplasia, total hip replacement surgery can be successfully performed to significantly extend the pain-free working career of the dog.

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Author

CPT Vince is a Resident in Small Animal Surgery at the College of Veterinary Medicine, North Carolina State University, Raleigh, North Carolina.