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Abstract

This case report describes the process for diagnosis of canine hip dysplasia, surgical management, and postoperative recovery from a total hip arthroplasty in a 6-year-old dog. While a total hip arthroplasty is a large surgery that takes planning with a skilled surgeon trained in total hip arthroplasty, it has a high success rate and the ability to let patients return to a normal, functional, less painful life. Veterinary nursing care during the entire process is critical to achieve the patient's best possible outcome.



SURGERY

Hip, Hip, Hooray! Total Hip Arthroplasty in a 6-Year-Old Dog

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Hip dysplasia is the most common orthopedic condition in dogs. Hip dysplasia refers to the laxity of the coxofemoral joint. As the disease progresses, it can be the cause of joint inflammation and secondary osteoarthritis, which ultimately results in clinical discomfort and disability of canine patients.¹ The cause of hip dysplasia has been long studied; it is linked to genetic inheritance and environmental factors such as nutrition, body condition score, and hormonal factors.²

Canine hip dysplasia can affect any breed of dog but is most reported in large-breed dogs, excluding sight hounds such as borzois and greyhounds.¹ Unfortunately, the diagnosis and treatment of this disease are still widely debated among professionals. Hip dysplasia will typically present as sudden, acute onset in juveniles or chronic,

degenerative progression of the disease in adult dogs.¹ In juveniles, this acute onset is due to laxity of the joint causing the femoral head to not sit snugly in the acetabulum of the pelvis. As adults, dogs will typically be presented because of osteoarthritis pain due to the degeneration and remodeling of the coxofemoral joint. Typically, there will be major differences in stance and gait between juveniles and adults with hip dysplasia. Juvenile patients will present with a wide base stance in the pelvic limbs to attempt to minimize movement of the femoral head within the acetabulum and against the acetabular rim via compressive forces. Adults will present with a narrow base stance in the hind to try to alleviate pain by standing with the femoral head antilevered and in forced subluxation.¹

Take-Home Points

- Canine hip dysplasia is a common orthopedic condition seen in veterinary clinics around the world.
- Total hip arthroplasty has a high success rate, increasing functionality and decreasing orthopedic pain in dogs, with the ability for patients to return to normal lives.
- Veterinary nurses are utilized at each step of the process in the diagnosis of canine hip dysplasia, surgery, and recovery.



In this case report, a middle-aged dog was presented with a lifelong history of slowly progressing lameness. Surgical correction of hip dysplasia can be categorized into prophylactic, salvage, and palliative procedures. This case will focus on a salvage procedure, a total hip arthroplasty (THA).

SIGNALMENT AND HISTORY

A 6-year-old, spayed female German shepherd/husky mixed-breed dog was presented with a history of nondescript lameness of her bilateral pelvic limbs. Six months prior to presentation to the orthopedics department, the patient was seen by an emergency service for hemorrhagic gastroenteritis. At the emergency service, the patient underwent abdominal radiography to rule out intestinal obstruction. While the patient was not obstructed with an intestinal foreign body, other radiographic findings showed the cranial portion of the pelvis and revealed a moderate amount of osteoarthritis; shallow acetabula; and thickened, mildly irregularly margined femoral heads and necks. With these images, this patient was diagnosed with moderate bilateral hip dysplasia.

When seen by the orthopedic service, the owner described weight-shifting lameness of the dog's pelvic limbs, inability to jump into the car, and a generally irritable nature that had progressed over the past few years. The dog had been adopted as a 4-month-old puppy from a rescue. Prior history was not known. When questioned about the dog's behavior as a puppy, the owner recounted that the patient would rarely jump on the bed and, if she got on the bed, acted as if she could not get down. The patient would regularly only put her front limbs on a seat but would not jump up. Additional history was normal, with no major trauma or medical concerns except for recent gastrointestinal upset. The patient was up-to-date on parasite preventives and vaccinations.

INITIAL ASSESSMENT

At presentation, the patient weighed 24.2 kg (53.4 lb) and had normal vital signs and a body condition score of 4/9. She was extremely anxious upon examination; therefore, a limited orthopedic examination was performed while the patient was awake and revealed mild bilateral weight-shifting lameness and a sway to her typical gait. No pain was elicited on palpation and hyperextension of her stifles. The patient showed extreme intolerance to manipulation and extension of

both hips. Due to the patient's increasingly fractious behavior and previously confirmed radiographic diagnosis of bilateral hip dysplasia, she was not placed in lateral recumbency for full orthopedic examination. The patient was sedated for full examination and diagnostic workup with 10 µg/kg dexmedetomidine and 0.2 mg/kg butorphanol given intravenously.

Radiography was performed for presurgical planning purposes. Radiograph images included craniocaudal femur, lateral femur, ventrodorsal pelvis with hindlimbs in a frog-leg position and relaxed position, and lateral pelvis, as seen in **FIGURE 1**. These images are standard pelvic and femur images. Additional imaging to better view the acetabular rim was not needed. It is important to note that a true craniocaudal femur view is obtained with a cross-table radiographic image. This projection will allow for the most accurate femoral stem sizing by reducing the amount of foreshortening.¹ For these radiographs, a 10-mm calibration ball is positioned at the level of the bone being radiographed. This calibration ball is used to calibrate the orthopedic software used later by the surgeons.

These images revealed mildly progressive bilateral coxofemoral subluxation as compared to previous imaging and moderate to marked degenerative joint disease. These images were used by the orthopedic surgeons to plan implant sizes by using the orthopedic planning software. In this case, OrthoView (Materialise, materialise.com/en/healthcare/orthoview) was used to template the images and determine the approximate size of the implants.

Bloodwork for a complete blood count (CBC) and biochemistry profile, as well as a urine sample, was collected via cystocentesis while the patient was sedated for radiography. CBC, chemistry, and urinalysis were all within normal limits (WNL). Urinalysis was performed to screen for signs of a urinary tract infection, such as presence of bacteria, protein, and blood. As previously planned, the patient was sent home and scheduled for return in 1 week for a left THA. The owner was instructed to give maropitant 2 mg/kg PO at 10 PM the night before surgery to prevent nausea and emesis postoperatively as part of hospital protocol.

SURGICAL TREATMENT

The patient was returned to the orthopedic service the following week. The morning of surgery, the physical

exam was WNL except for painful hip extension. The patient was anesthetized and placed in right lateral recumbency. The dog was shaved from the last rib to the base of the tail and ventral midline laterally to the left to the wing of the right ilium; the entirety of the left hind limb proximal to the tibiotarsal joint was also shaved. The patient was started on cefazolin 22 mg/kg IV as an intraoperative antibiotic approximately 30 minutes before the beginning of the procedure and repeated every 90 minutes during the procedure.

Before entering the surgical suite, the patient was aseptically prepped with a 4% chlorhexidine gluconate scrub with saline to follow. Upon entering the surgical

suite, the patient was placed in a 3-post positioning device, and fluoroscopy was used to ensure the ischiatic tuberosities were vertically aligned and perpendicular to the floor. Once positioning was completed, 2 sterile 0.7% iodine solution applicators were used to aseptically prep the limb. Two sterile instrument tables were used for proper organization by the veterinary scrub nurse. Sterile drapes, an impervious stockinette, and an iodine-infused adhesive drape were placed to dress the sterile field. A slightly curvilinear skin incision was made caudodorsally to the hip extending cranially and distal along the shaft of the femur. Following dissection to the pelvis, the round ligament was cut with a Hatt spoon and the hip was luxated and

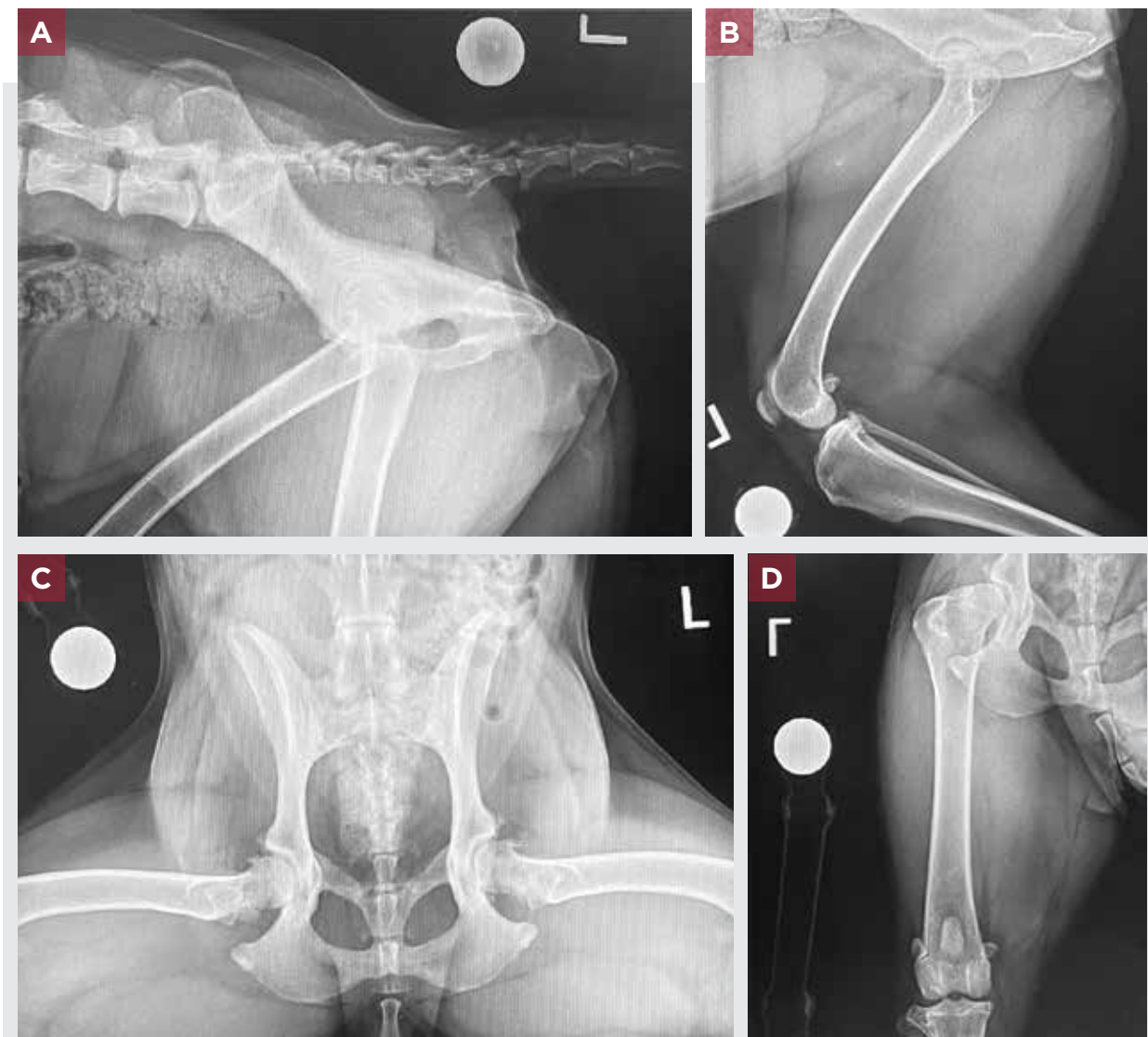


FIGURE 1. Preoperative planning radiographs of the patient's pelvis and left femur. **(A)** Lateral pelvis with the wings of the ilium properly superimposed. **(B)** Lateral femur with superimposed medial and lateral condyle. **(C)** Ventrodorsal pelvis shows correctly symmetrical wings of the ilium. **(D)** Craniocaudal femur with correctly centered patella.



externally rotated. The osteotomy of the femoral head was performed with a sagittal saw after marking the placement with a resection guide. For this case, the BioMedtrix Universal Hip System (biomedtrix.com) was used.

Next, the acetabulum was prepped and a 22-mm BFX cup was impacted to the level of the native acetabular rim. The femur was then externally rotated and prepped for implants starting with a 4-mm IM pin, then successive reamers (4-7) were used to open the femoral canal. Broaches were used as a final preparation of the femur for a successful fitting of a #6 CFX trial femoral stem. A large cement plug was placed within the femur. The femoral canal was pressure irrigated with a pressure irrigation gun and 1 L of PlasmaLyte solution. The surgical scrub nurse prepared a dose of poly(methyl methacrylate), also known as PMMA, with a Stryker Revolution injection gun system (stryker.com). The cement was injected into the femoral canal, and a #6 CFX femoral stem was placed and held as the cement cured. Trial heads were then placed on the stem and reduced into the artificial cup and evaluated for proper tension and alignment. A 14+5 head was determined to be the proper fit, and the implant was obtained from the circulating veterinary nurse and tapped into position by the veterinary scrub nurse.

Final assessment of range of motion and tension was performed prior to closing the surgical incision. The surgical site was lavaged with sterile saline before the surgeon began closure. Preclosure antiseptic lavage solution has been shown to increase the incidence of surgical site infections³; therefore, it was not performed in this procedure. A nonadhesive conformable bandage was used to cover the incision prior to the patient leaving the operating room. The patient's urinary bladder was manually expressed after removal from the operating table.

The patient remained anesthetized while postoperative radiographs were obtained (**FIGURE 2**). These images provide confirmation of proper implant placement. The surgical team assessed the radiographic images while taking into consideration the appropriate angle of lateral opening and retroversion angles. As this stem implant was cemented, there should be a minimum of 2 mm of mantle surrounding the prosthesis, and the stem should be centered within the medullary cavity of the femur.¹ Implant placement was confirmed successful by the head surgeon, and the patient was transferred to the intensive care unit for recovery.

POSTOPERATIVE CARE

During recovery and before extubation, the patient had 1 episode of regurgitation. Upon extubation, the patient became very dysphoric and required 2 doses of 2 µg/kg IV of dexmedetomidine for sedation and safe recovery. Because she had a normal chemistry and CBC, the patient was maintained on isotonic crystalloid fluids at 60 mL/kg/day as her fluid loss was not ongoing, but she may have had a decreased ability/desire to drink adequately on her own. Isotonic crystalloids have an osmolality approximately equal to that of blood and are often used in maintenance fluid therapy as well as resuscitation.⁴ Analgesics consisted of carprofen 2.2 mg/kg PO or SC every 12 hours and a fentanyl constant-rate infusion of 3 µg/kg/hr.

Due to regurgitation upon recovery and a history of hemorrhagic gastroenteritis, the patient was started on maropitant 1 mg/kg IV q24h and pantoprazole 1 mg/kg IV q12h, then switched to omeprazole 1 mg/kg PO q12h once she resumed eating in preparation for discharge.⁵ Due to patient temperament, she was also started on trazodone 6 mg/kg PO q8h. Further postoperative care included icing the surgical incision every 4 hours and walking the patient with sling support every 6 hours.

The patient recovered well and was able to be sent home the following day with instructions to return in 10 to 14 days for incision check and a physical rehabilitation consultation. The patient was also prescribed 3 medications to be given at home with instructions as follows:

- **Trazodone 100-mg tablets**—Give 2 tablets by mouth every 8 to 12 hours as needed for sedation.
- **Gabapentin 300-mg capsules**—Give 1 capsule by mouth every 8 to 12 hours as needed for sedation.
- **Carprofen 100-mg tablets**—Give ½ tablet by mouth every 12 hours for 14 days. Give with food.

No antibiotics were continued postoperatively because there was no break in aseptic and sterile technique during surgery.

OUTCOME

The patient returned for physical rehabilitation appointments twice weekly until full recovery and discharge from the orthopedics team. During the physical rehabilitation sessions, the veterinary nurses performed several exercises to begin to build strength and muscle back into the patient's left hind limb. These

exercises included assisted standing and weight-shifting, controlled walking, cavaletti rails, cookie stretches, and underwater treadmill therapy. The underwater treadmill therapy was planned to be added only following repeat radiography at 4 weeks postoperatively.

At 4 weeks postsurgery, radiographs were repeated in the same fashion as the images taken preoperatively and immediately postoperatively: ventrodorsal pelvis, lateral pelvis, craniocaudal femur, and lateral femur. The

patient was sedated for imaging with 10 µg/kg dexmedetomidine and 0.2 mg/kg butorphanol intravenously in the right cephalic vein. These radiographs revealed an improved acetabular cup position that was seated deeper within the acetabulum, with a reduced gap present between the dorsomedial margin of the acetabular cup and the medial wall of the acetabulum (**FIGURE 3**). At that time, the patient was released to continue physical rehabilitation and begin underwater treadmill therapy. Continued crate rest at



FIGURE 2. (A) Lateral pelvis, (B) lateral femur, (C) ventrodorsal pelvis, and (D) craniocaudal femur radiographs of the left total hip arthroplasty immediately postoperation.



home with limited activity was recommended. Trazodone and gabapentin were continued on an as-needed basis for the duration of recovery. The next recheck was scheduled for 8 weeks postoperation.

At 8 weeks postoperation, radiographs were repeated in the same fashion as previously: ventrodorsal pelvis, lateral pelvis, craniocaudal femur, and lateral femur. The patient was sedated for imaging with 10 µg/kg dexmedetomidine and 0.2 mg/kg butorphanol intravenously in the left lateral saphenous vein. These

images revealed static implants and muscle loss of the left pelvic limb. At that time, the patient was released to a slow return to normal activity. It was recommended that the patient increase activity over the next 4 weeks to prevent concurrent injury following long-term crate rest and activity restriction.

The owner followed up with the orthopedic service 1 year later and described the patient as pain free in the left hip, able to jump into the vehicle for the first time in her life, and back to normal activity and lifestyle at



FIGURE 3. (A) Lateral pelvis, (B) lateral femur, (C) ventrodorsal pelvis, and (D) craniocaudal femur radiographs of the left total hip arthroplasty 4 weeks postoperation.



home. The owner plans to move forward with a right THA when the patient develops clinically significant lameness and pain.

DISCUSSION

From start to finish, a THA is an in-depth case that needs to be carefully planned and managed by the surgical team. Risks such as surgical site infection are reduced by careful preoperative screening for urinary tract infections and signs of pyoderma on the patient's skin. Bacteria present in urine could cause a risk of translocation if the patient urinates on itself postoperatively.⁶ Signs of pyoderma include pustules and epidermal collarettes. If these skin lesions are present within the surgical field, surgery should be postponed until the skin lesions have resolved. Through careful patient preparation, veterinary nurses can assist in reducing the risk of surgical site infection.⁷ As stated above, using sterile saline as a surgical lavage is preferred over antiseptic lavage because this actually increases the risk of surgical site infection.³

As part of this THA, the femoral stem was cemented with PMMA while the acetabular cup was impacted into position. With the BioMedtrix Universal Hip System, a THA can be fully cemented fixation (CFX), biologic fixation (BFX), or a hybrid of both, as the implants are interchangeable. BFX will also be referred to as "press-fit." This case is a hybrid THA because it utilizes a BFX cup and a CFX stem. The acetabular cup contains a biological titanium matrix, which allows the bone to integrate into the implant. While there are other total hip implant systems, their use with BioMedtrix is not recommended and may result in implant failure.⁸

SUMMARY

The process for a THA is extensive and a large decision for an owner to make. Some of the factors for owners and surgeons to weigh during patient selection include severity of clinical signs, skin condition, concurrent diseases, implant availability, owner compliance, and procedure cost. Success rates for a THA are relatively high, averaging 95% with a complication rate from 5% to 22%.¹ Complications can be classified into biological failure or mechanical failure. Biological failure examples would be aseptic loosening of the implants, septic loosening, and stress protection. Mechanical failure examples are luxation, femur fracture, acetabular fracture, and subsidence of the

femoral stem. Fortunately, the patient described had a positive outcome and did not experience complications.

During this patient's journey to complete recovery, she had numerous veterinary nurses caring for her, from anesthesia monitoring to radiology veterinary nurses providing immaculate imaging to orthopedic and physical rehabilitation veterinary nurses helping her have the best possible outcome. Registered veterinary technicians provided this patient with constant care throughout her entire hospitalization and recovery, leading to a healthy patient and a happy owner. **TVN**

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Marcella (Marci) is a registered veterinary technician at Purdue University Veterinary Hospital. She is a lead veterinary nurse on the surgical team and serves as an orthopedic surgery floor veterinary nurse while also acting as a scrub, circulating, and anesthesia veterinary nurse. Marci has a special interest in total joint replacements such as for hips, stifles, and hocks. She plans to begin working toward a VTS credential in surgery in the near future. She earned her bachelor of science degree in ecology, evolution, and environmental biology in 2011 from Purdue University and associate degree in veterinary technology from Harrison College in 2018.