

Decision making in the management of canine hip dysplasia

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KEY POINTS

- Client education and early diagnosis are key to decision making in the treatment of canine hip dysplasia and hip arthritis.
- As arthritis progresses, the reasonable options decrease as does the chance of their success.
- A minimum database for decision making includes radiographs and testing for the Ortoloni sign.
- Options for management include triple pelvic osteotomy, physical therapy, femoral head and neck excision and total hip arthroplasty.

Introduction

Canine hip dysplasia is a complex, multifactorial disease. Decision making starts with puppy selection and continues with management of diet, exercise and veterinary examination. Early diagnosis is essential and requires specific diagnostic test be done in the juvenile dog. Finally, decision making is necessary to select the 'best' treatment for that individual dog and owner.

Triple pelvic osteotomy surgery may correct hip dysplasia and prevent future arthritis. TPO must be performed prior to significant arthritis (i.e. dogs less than 1 to 1.5 years old). Therefore, diagnostic screening must be performed on juvenile dogs if TPO is to be an option. Physical therapy is the non-surgical option and consist of promoting muscle mass via exercise, preventing or correcting obesity, and, least important, anti-inflammatory drugs. Dogs with arthritis will not exercise enough by free choice to increase their muscularity. Owners must regularly exercise their dog, preferably with low impact exercise such as swimming or walks on a leash.

If physical therapy fails, surgical treatments of hip degenerative joint disease are femoral head and neck excision (FHNE/FHO) or total hip arthroplasty (THA). FHNE is indicated in small dogs or large dogs when

finances prohibit THA. Contrary to popular belief, the majority of large dogs benefit from FHNE, especially if they are well muscled and not obese.

The definitions of, and distinctions between, hip dysplasia and arthritis need to be understood before informed decisions can be made.

- CHD is laxity of the hip joints, resulting in complete or partial dislocation of the hips, that develops between birth and six to nine months of age (1–3) (**Figure 1a**). The hips are normal by all known tests when a puppy is born, but laxity develops during the dog's rapid growth to adulthood (1–3).
- Arthritis, or DJD, is the progressive degeneration of a joint's structure and function which can not be cured. DJD is secondary to CHD, that is, degeneration of the joint is caused by the abnormal mechanics of hip laxity. It is common, but erroneous, to refer to the middle aged dog in **Figure 1b** as having hip dysplasia. In fact, the dog has arthritis of the hips which was probably caused by CHD. The distinction is important because joint laxity can potentially be corrected, whereas a joint with DJD can never be returned to normal.

Buying and managing a young dog

The first decisions involve trying to obtain a dog that will not develop CHD and subsequent arthritis. Unfortunately, there are no guarantees. A common misconception is that CHD is a 100% inherited disease, and therefore could be avoided by selective breeding. A gene (or genes) 'carrying' CHD has not yet been identified. Selectively breeding dogs without CHD has been proven to reduce the incidence, but does not eliminate the disease (3, 4). In addition, non-inherited factors such as nutrition and activity (discussed below) are known to influence the development of CHD.

However, genetics undoubtedly plays a role in CHD. For example, a dog inherits the fact that it is a Saint Bernard rather than a Chihuahua. Size alone, however, is not a reliable predictor of the risk of CHD. The Boykin Spaniel has one of the highest percentages of CHD, whereas the Siberian Husky and Borzoi are among the least commonly affected.

The percentage body fat has also been shown to correlate to the frequency of CHD (3). The breeds with 5–10% body fat tend to be stocky and clumsy, and to have ill-defined soft muscles and loosely adherent skin. Breeds with 1–2% body fat tend to be co-ordinated, have well defined firm muscles and tightly adherent skin. Compare, for example, the Saint



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Figure 1a Radiograph of hip laxity without significant degenerative joint disease.



Figure 1b Radiograph of advanced degenerative joint disease.

Bernard and the Irish Wolfhound. Both are giant breeds, yet the Saint Bernard has about a 50% frequency of CHD versus the Irish Wolfhound at about 6%. The Orthopedic Foundation for Animals (OFA) publishes a list of breeds and the percentage of each breed with CHD. It should be remembered that OFA's percentages are based on the radiographs submitted to them for evaluation, and the percentage of dogs in the general population with CHD is probably higher. Nevertheless, the OFA list, and those produced by similar organisations in other countries, will help owners know the relative risk of CHD with a puppy of one breed versus another breed. In addition, if both parents are OFA certified then the risk of CHD in the puppies may be greatly reduced, but not eliminated (4).

The second group of decisions involve how the dog is managed from puppy to adult to minimise the risk of CHD (**Table 1**). CHD is a juvenile or developmental disease; by all known tests the hips are normal at birth, and therefore by definition CHD is not a congenital disease. Laxity of the hip joints, or CHD, develops as the dog rapidly grows from a puppy to adulthood (1–3). The most rapid growth in stature (bone length) occurs between birth and six months of age. A relevant engineering principle is that each time the height of a structure doubles, the supporting foundation should triple in strength. Many orthopedists believe that hip laxity develops partly because the size of the dog increases faster than does the strength of the muscles and ligaments supporting the hip joint during the first six months of life (1–3, 5). There are several facts that support this concept.

- First, laxity of the hips (that is, CHD) can usually be palpated by six to nine months of age.
- Second, factors that increase the rate of growth such as high calorie diets (often high fat diets) and high calcium diets have been proven to increase the frequency of CHD (6, 7). *Ad libitum* feeding, which promotes caloric intake, has also been incriminated (7). One study of 222 German Shepherds reported that the 111 puppies weighing less than the group mean at two months of age had a 37% incidence of CHD at a year of age compared with 63% CHD for the 111 dogs weighing over the group mean (3). Promoting rapid growth does not significantly influence the dog's adult size, but certainly does increase the risk of CHD and other juvenile bone and joint diseases (7, 8).
- Third, increased stress on juvenile hips has been shown to increase the incidence of CHD (3). Puppies continuously caged until 6 months old had stable hips and avoided CHD (3). Unfortunately, the lack of socialisation made them unacceptable as pets or working dogs. Low impact exercise should be encouraged (for example, walks on a leash, swimming) to promote muscle mass and strength, while high impact running and jumping should be minimised (perhaps by caging the dog when the owner is not home) during the first six months of life (3, 5).

Some dogs, albeit relatively few, still develop CHD despite these precautions. CHD is truly a multifactorial disease, and we probably do not yet

Table 1

Summary of the management impositions on dogs with hip dysplasia < 1 year old

- Abundant low impact exercise (e.g. leashed walks, swimming)
- Low calorie, normal, or restricted calcium food. Keep to specific meals, rather than *ad libitum* feeding
- Periods of cage rest (e.g. when owner is not home)

understand all of the factors contributing to this disease.

Diagnosis and screening

Young dogs with CHD, but prior to the onset of significant DJD, typically have very mild clinical signs. A slightly narrowed stance, running with both back legs moving together ('bunny hopping'), slight difficulty rising and exercise intolerance are often absent or so mild that the owners do not realise their dog has a problem until the more obvious clinical signs associated with DJD occur. Therefore, the author recommends that at risk dogs, especially larger breeds, be examined by their veterinarian between six and nine months of age. Since juvenile dogs, especially in large breeds, are at risk for several juvenile bone and joint diseases, a complete orthopaedic examination is recommended.

The minimum examination should include an Ortolani test and radiographs. Sedation makes both these tests easier to perform and results in better positioning. The muscular resistance of a large awake dog can result in a false negative Ortolani test. Sedation (or general anaesthesia) is required to obtain accurate positioning for radiographs as even mild malpositioning can result in erroneous interpretation.

Ortolani test

A positive Ortolani test is a result of an induced luxation/subluxation of the hip the joint and then its reduction (**Figure 2**). Therefore, a positive Ortolani test by definition is diagnostic of CHD. An overtly positive Ortolani sign (easily palpated drop of the femoral head into the acetabulum and an audible 'clunk') is most typical for young dogs with mild DJD. As DJD progresses, the dorsal acetabular rim is worn down, the acetabulum becomes shallow and there is fibrosis of the joint capsule which makes the Ortolani sign less obvious, or impossible, to obtain.

One of the most sensitive signs of early arthritis is pain accompanying full hip extension. As DJD progresses there may be an inability to fully extend the hip joint.

Palpation alone may fail to diagnose CHD in some dogs because the femoral head is constantly luxated a long distance from the acetabulum and thus not be readily reduced. In other dogs the subluxations may be mild enough that they are not palpable. Difficulties may also be encountered in dogs with advanced DJD, despite being less than a year of age. Likewise, radiographs alone will fail to diagnose some dogs with CHD but without DJD.

Radiography

The veterinarian should remember that radiographs are two dimensional still images taken in a fraction of a second, and may not reveal the dynamic action of abnormal hip motion. For example, a ventrodorsal radiograph of the hips with the legs extended and the stifles internally rotated (OFA style) tends to reduce the femoral head into the acetabulum. That still image may not show subluxation, but that does not mean that the dog will not have a positive Ortolani sign. Several techniques have been described to radiograph hips while they are under stress, which promotes subluxation.



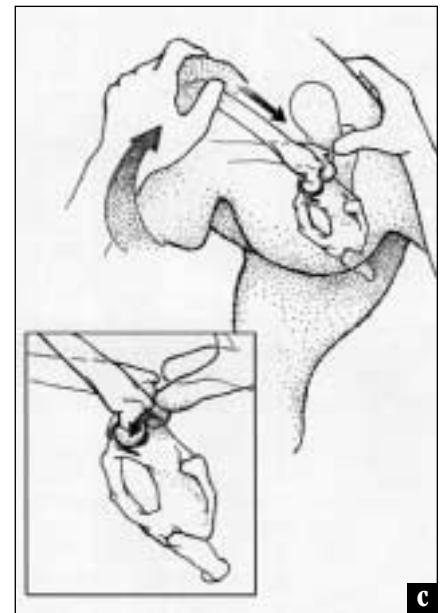
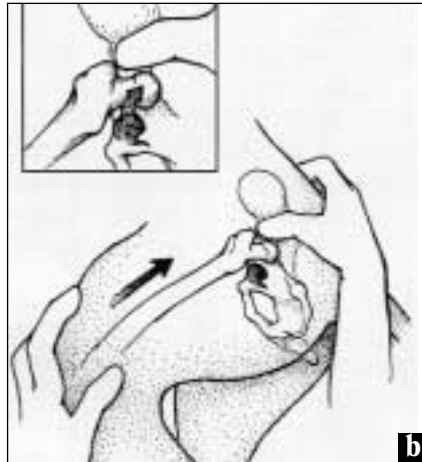


Figure 2a The Ortolani test begins with the leg in a normal standing position and dorsal pressure is applied to the femur.
Figure 2b Dorsal pressure with the left hand luxates (or subluxates) the femoral head dorsally (Barlow sign).
Figure 2c Abduction reduces the hip, which is palpable with the right thumb (Ortolani sign).

The Penn Hip System™ involves ventrodorsal radiographs with the femur in a neutral position (stifles toward ceiling), which is where the joint capsule is most lax (9). A bolster is placed between, and just proximal, to the stifles. At the moment of X-ray, the stifles are pressed together which levers the femoral heads out of the acetabuli. A ratio of measurements taken from the radiographs (the distraction index) indicates the dog's risk for future DJD of the hips.

More recently, a similar technique has been described for a ventrodorsal stress radiograph (10). Instead of the bolster just proximal to the stifles, downward pressure is placed on the stifles which tends to luxate the femoral head dorsally (the first part of the Ortolani test, or a Barlow test). Another recently described technique is a dorsoventral radiograph using similar principles (11). A radiolucent pad (for example foam rubber) is placed under the dog with holes cut out to allow the stifles to rest on the table and support some of the dog's weight (11). This technique mimics the normal standing angle of the femur and mimics weight-bearing forces that would tend to luxate the hip. The latter two techniques have not yet withstood the test of time, but are logical and may prove to be valuable in diagnosis of hip joint laxity due to CHD.

Management options

Early intervention is key to satisfactory treatment of dogs with CHD/arthritis, whether the treatment is conservative or surgical. Muscle atrophy, especially if advanced, decreases the chances of good return of function regardless of the treatment. In addition, advanced bony remodelling and/or excessive laxity in the coxofemoral joint worsen the prognosis with some surgical treatments. Client education is critical as they present their dog to a veterinarian early in the course of the disease.

Treatment options for dogs with CHD are triple pelvic osteotomy (TPO), physical therapy, femoral head and neck excision (FHNE) and total hip arthroplasty (THA) (Table 2). Selection of a treatment is based on two guiding principles:

- Education of the client on the pros and cons of each treatment so that they can make informed decisions about their dog's treatment.
- Not offering treatments that are unreasonable, such as TPO, for a dog with advanced arthritis.

several factors, with the severity of DJD being one of the most important.

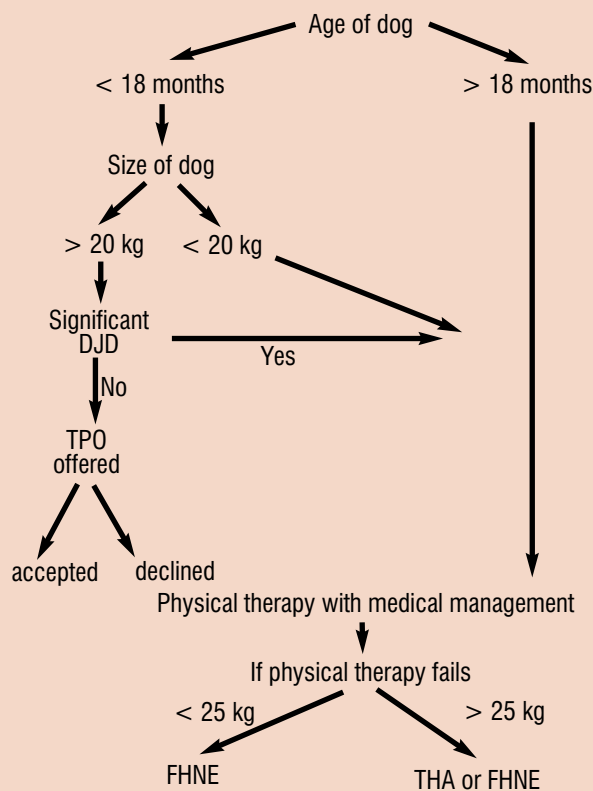
Triple pelvic osteotomy

Triple pelvic osteotomy is intended to minimise or prevent DJD by stabilising a lax hip joint (CHD) prior to the onset of DJD (12–14) (Figure 3). TPO is not a treatment for DJD. In an ideal world all TPO surgeries would be performed on dogs without any DJD. However, few such cases are presented to the orthopaedic surgeon (see routine screening recommendations above), and many dogs with CHD and mild to moderate arthritic changes are significantly helped by TPO. Therefore, evaluation of the severity of DJD is critical. Since TPO is a preventative surgery, it should not be considered in dogs over 18 months of age (some orthopaedic surgeons use 12 months as an age limit) even with minimal indications of arthritis and a distinct Ortolani sign. However, being less than 18 months (or 12 months) old does not guarantee there is minimal arthritis, as the author has seen numerous dogs with advanced DJD as young as eight months old. Radiographic evidence of arthritis, the previously described character of the Ortolani sign, muscle atrophy, the degree of hip extension and pain with extension and abduction should all be considered. The bony anatomy should be near normal. In addition, femoral heads luxated a great distance from the acetabulum can be difficult if not impossible to capture in the acetabulum with a TPO. Surgeons should not offer TPO if they believe the risk of DJD progressing, despite the TPO, is too great to justify the procedure. Unfortunately, there are no clear objective criteria to indicate when there is too much DJD. Conservative criteria of less than 12 months of age and virtually no evidence of DJD will usually avoid failures (continuing DJD), but will also eliminate some dogs that would have benefited from TPO surgery (14). The author suggests frank discussions about risk with owners and to err on the side of caution.

- A surgeon can usually correct the physical abnormality of hip joint laxity if the bony anatomy is normal.
- A surgeon can not restore an arthritic hip to a normal hip.

Owners should be made aware that any arthritis already present will not be corrected by TPO surgery. In addition, as the DJD becomes more severe there is increased risk of DJD progressing despite the TPO. Even if the dog is a good candidate, TPO surgery is not for everyone. One reason is that the surgery is expensive. In addition, the owner should be made aware that not all dogs with CHD will develop crippling arthritis. Predicting whether an

Table 2

Decision making for dogs with hip dysplasia/arthritis

individual dog will develop crippling arthritis or arthritis that is a minor nuisance is not possible and at best would be an educated guess based on the current clinical and radiographic findings. TPO surgery is for those clients wanting to minimise the risk of crippling arthritis. If TPO surgery is not offered or is declined by the owner, then physical therapy is the next logical recommendation.

Physical therapy

Physical therapy involves exercise, avoiding obesity and, least important, medication. The normal progression of arthritis results in decreased leg use due to pain. Less use of the leg necessarily results in muscle atrophy. Normally, some of the weight bearing forces go through the muscles surrounding the joint, as well as the joint itself (1). With less muscle supporting the hip, a higher percentage of the weight bearing forces go through the arthritic joint. An increased percentage of the weight bearing load through an arthritic joint increases the lameness and pain from the joint, thus continuing the cycle.

Exercise is necessary to promote muscle mass and strength, thus breaking the typical cycle just described. The author recommends exercise every Monday, Wednesday and Friday. Ostensibly, the dog will feel more pain the day after exercise. Therefore, on Tuesday and Thursday the dog should be rested and given a non-steroidal anti-inflammatory agent (NSAID) if necessary. Low impact exercise is preferable, such as swimming or leashed walks. However, if higher impact exercise such as retrieving is the only way the dog will receive regular exercise then high impact exercise is better than not exercising the dog at all. The owner is in the best position to judge how much exercise is appropriate in a day. The analogy to a human trying to get into shape is appropriate. If the individual exercises too little, then progress will not be made. If the individual exercises too much

then the exercise programme will soon be abandoned. Dogs will not exercise enough on their own, so the owner must make a substantial time commitment to assure their dog is receiving an appropriate amount of exercise. Noticeable improvement such as longer periods of exercise, more muscle, less discomfort and less need for aspirin, should be apparent in six to eight weeks, if the programme is going to be successful in that individual. Physical therapy is most successful for dogs with mild or moderate clinical signs that improve after six to eight weeks of physical therapy.

Medications are useful primarily because they promote the ability to exercise. By themselves, NSAIDs do not treat arthritis, they just mask the clinical signs of inflammation. NSAIDs are the most commonly used anti-inflammatories; they include aspirin, aspirin-based drugs, carprofen and etodolac. The author does not recommend other NSAIDs such as ibuprofen and acetaminophen for use in dogs (1). It must be remembered that arthritis is a lifelong disease, and even drugs as relatively safe as the NSAIDs recommended can, and do, have serious side effects if overused. Therefore, the author recommends using the NSAIDs as little as possible, and not more often than every other day. Increasing the dosage of an NSAID cannot replace the value of exercise, but does increase the risk of deleterious effects to the gastrointestinal system, liver and kidneys (17, 18).

Another common, and usually effective medication, is the polysulfated glycosaminoglycan preparations which have a composition similar to normal joint fluid. Some of these are directly anti-inflammatory and increase the concentration of lubricants in the synovial fluid. They may be administered by injection several times during the first two weeks followed by injections as needed, typically every three to four weeks.

Nutraceuticals are classified as nutrients by the US FDA and therefore do not have to prove safety or efficacy via scientific study (17). [Similarly in Europe, functional claims describing the effect of a product, of a nutrient element or another substance contained in the product on the normal function of the body do not require authorisation. They must of course be capable of substantiation by the manufacturer. Many nutraceuticals are promoted as useful in the treatment of arthritis but objective evidence of their efficiency has been lacking.]*

Femoral head and neck excision

Femoral head and neck excision (FHNE) (Figure 6) is a surgical treatment for arthritis of the hip joint. Indications include failure of physical therapy or if physical therapy is unlikely to be of benefit (for example, in Legg-Calve-Perthes disease), dogs too small for total hip arthroplasty (THA), or if THA is not financially possible. Complete removal of the femoral neck is critical, and is facilitated by the modified Watson-Jones approach (Figure 6a) which elevates the vastus lateralis and vastus intermedius muscles from the femoral neck.

The osteotomy should extend from the medial edge of the greater trochanteric ridge to the lesser (second) trochanter (Figure 6b). Care should be taken to cut in the craniocaudal plane to avoid leaving a sharp point of neck caudally, which is not readily visible at surgery. An assistant holding the leg with the patella straight up toward the ceiling and angling the osteotome straight down or slightly caudally will result in full removal of the femoral neck. Various FHNE methods have been described, but the standard technique yields the best results (20, 21). Transposition of the deep gluteal muscle over the acetabulum has, in the author's experience, not resulted in significant morbidity and subjectively has yielded good results. Transposition of a biceps femoris muscle flap, in contrast, does have significant morbidity. The flap does not survive beyond 16 weeks, and the clinical results are not as good (21).

Small dogs tend to have good clinical results with FHNE. There is a common misconception that FHNE should not be performed on medium to large dogs because they invariably will not have good clinical results. Eighty five percent of large dogs have a good to excellent outcome in the owners





Figure 3 Radiograph of a triple pelvic osteotomy (TPO) on one side. Note depth of femoral head in the acetabulum compared to the unoperated side. The unoperated side demonstrates laxity of the joint, but minimal radiographic evidence of degenerative joint disease.

opinion (20). In the author's opinion, good muscle mass and lack of obesity are as important as the dog's size. Although THA is preferred to FHNE, lean and well muscled large breed dogs can benefit from FHNE. Leashed walks or swimming beginning 7–10 days after surgery until the dog is using the leg well (3–4 weeks) is important to avoid muscle atrophy and to the long term prognosis.

Total hip arthroplasty

Total hip arthroplasty is surgical replacement of the hip in dogs with clinically significant arthritis (22) (**Figure 7a**). The dog should have a closed physis at the greater trochanter (over nine months old) and have a femur large enough to accommodate the prosthesis (typically more than 25 kg). One absolute contraindication is the absence of significant lameness, regardless of the radiographic appearance (22). Force plate analysis of dogs with THA indicates that weight bearing is about 92% of weight bearing through a normal hip (23). Therefore, dogs with extremely mild lameness may actually have less weight bearing after THA. The clinician should ensure that NSAIDs, steroids or other anti-inflammatory drugs are not masking the clinical signs when evaluating lameness and pain with extension of the hip joint. In contrast, delaying surgery until the lameness and muscle atrophy are advanced will yield poorer results.

Another absolute contraindication is infection anywhere in the body (22). Infection of THA can be disastrous, and haematogenous routes of infection from bacterial cystitis, gingivitis, dermatitis, etc. can and do occur. Physical and laboratory (for example, urinary culture) examinations should be performed routinely before THA. Relative contraindications include other orthopaedic diseases (for example, cruciate ligament rupture), neurological disease (such as intervertebral disc herniation) and systemic or major organ system diseases (for example, liver disease) (22).

Other, orthopaedic problems should probably be treated prior to THA. Dogs with neurological problems affecting the rear legs, which can not be corrected, should probably not have THA (22). Whether the presence of a major systemic disease impacts on decision making depends on the disease and the owners preferences. For example, an owner who's dog has a disease that may not prove fatal for years may reasonably decide to relieve pain from the arthritic hip via THA.

Dogs without these contraindications may still be rejected for THA by the surgeon or owner. Excessive remodelling of the hip may increase the risk of complications, for example, by reducing the bone stock necessary to correctly position and hold the THA (**Figure 7b**).

The importance of obesity

Prevention, or correction, of obesity is critical to the successful management of arthritis. The purpose of the musculoskeletal system is to



Figure 4a Watson-Jones approach exposing the entire femoral neck to facilitate complete excision. Line indicates correct location of the osteotomy.



Figure 4b Radiograph of a femoral head and neck excision (FHNE).

carry the body's weight. Excessive weight, especially in the useless form of fat, only exacerbates lameness. The author has repeatedly seen cases in which the correction of gross obesity results in a substantial improvement in the lameness. The veterinarian should be very specific in prescribing a diet. A casual comment in the style of 'by the way, your dog needs to lose weight' will, in the author's experience result in failure.

[Feeding between 40 and 60% of the animal's maintenance requirement at its target weight will lead to a weight loss averaging approximately 1% per week. Information on the caloric density of dog foods can be obtained from the manufacturer. A preferred alternative is to prescribe a commercial diet which is designed to result in a gradual, controlled loss of weight by decreased energy intake while remaining balanced in all other nutrients. Any treats, or other sources of food should be excluded, or included in the total number of daily calories calculated by the formula above.]*

The author routinely checks thyroid function in obese dogs. Based on our endocrinology laboratory and the Veterinary Medical Data Base (Purdue), about 1% of all dogs are hypothyroid. Failure to treat hypothyroidism will make weight loss difficult, if not impossible by diet

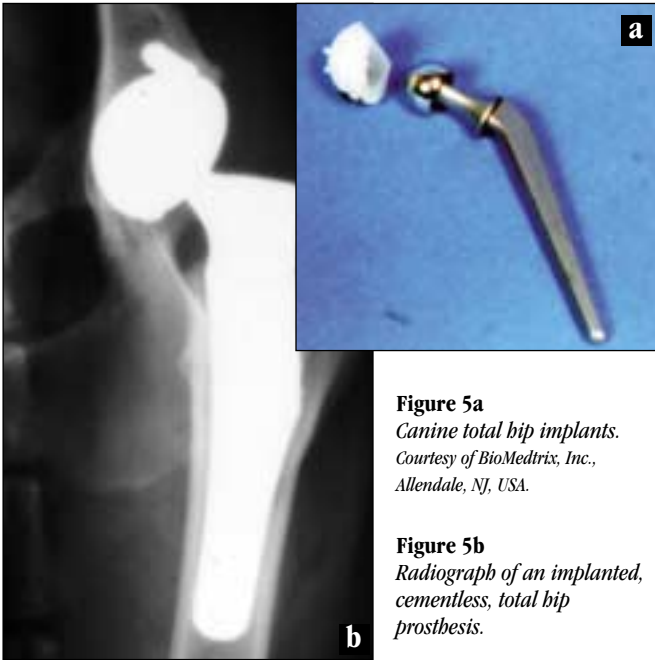


Figure 5a
Canine total hip implants.
Courtesy of BioMedtrix, Inc.,
Allendale, NJ, USA.

Figure 5b
Radiograph of an implanted,
cementless, total hip
prosthesis.

T₄, and the total T₄/TSH (Thyroid Stimulating Hormone) ratio are also useful thyroid screening tests.

It is intuitive that a slim, muscular athletic dog will deal with arthritis better than an obese, poorly muscled couch potato. In the author's experience, the physical therapy programme described has been successful in preventing or delaying the need for surgery in many dogs over the last 12 years. However, the physical therapy programme is labour intensive and therefore not for every owner. Physical therapy may fail, work for a few months or years, or last the lifetime of the dog. If the physical therapy programme fails despite all efforts, then surgery is clearly justified. Muscle mass and strength affects the outcome of surgical treatments for arthritis. Therefore, owners should be aware that if physical therapy is failing they should not wait until there is significant muscle atrophy before opting for surgery. Indications that physical therapy is failing include muscle atrophy apparent to the owner, consistent lameness that is apparent to the owner, increased need for NSAIDs, decreasing amount of exercise, etc. Periodic examination and consultation with their veterinarian is advisable.

* Editor's comments

alone. The author prefers the free T₄ test, which if performed by equilibrium dialysis is very reliable even though it is more expensive. Total

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