

Preventing injury in sporting dogs

By Wendy Baltzer, DVM, PhD, DACVS

Practice makes perfect—and possibly for fewer injuries. By discussing with owners the right conditioning tailored to dogs based on the activity they participate in, you can prolong your patients' healthy participation in canine sports.

Recently, sporting events for dogs and their owners have increased in number and popularity, with more than 940,000 entries in 2,461 American Kennel Club-sponsored agility trials recorded in 2010 alone.¹ The North American Flyball Association registers more than 16,000 dogs a year in their events, and no breed or age restrictions are placed on the canine participants.²

Many pet owners enroll their dogs in sporting activities without prior knowledge of the sport and what injuries can occur, as outlined in the previous article, "Sporting dog injuries." Unfortunately, there is scant research on the risks to dogs engaging in these sports and on what is required to prevent injuries. But much research involving people and horses has been performed and can be extrapolated to dogs to help us educate owners and trainers and prevent injury in sporting dogs. By preventing injury, our goal is also to sustain performance and allow dogs to participate in sports for many years.

SPORT-SPECIFIC CONSIDERATIONS

In people, maintenance of fitness is often defined as at least 30 minutes of moderate-intensity activity a day.³ Fitness in dogs has not been fully defined, and no physiologic studies have adequately determined canine fitness. But the required fitness level of a sporting dog depends on the sport it engages in and should be adapted to the amount of exertion, agility, and endurance required for the sport.⁴ A dog's training should reflect that effort and try to mimic the conditions as much as possible—this concept is termed *specificity*.⁴ The intensity and duration of exercises will vary depending on the sport the dog is training for.

Sledding

Sled dogs must have high endurance and strength to pull a sled many hours over long distances and rough terrain. They must be exercised for extended periods every day and be required to strengthen muscles as well, so swimming would not be an appropriate exercise since it would not place the stress and strain on the musculoskeletal system that a sled would.

Herding

Herding dogs, similar to sled dogs, must have endurance for the long arduous task ahead.

Search and rescue

Search and rescue dogs must have endurance similar to that of sled dogs, while being able to navigate in never-before-experienced conditions. They must also have excellent balance to remain uninjured in conditions in which their safety may be in jeopardy.

Racing and coursing

Racing and coursing dogs can be subject to stress fractures since they often race on hard surfaces without shock absorption and always in the same direction on a circular or oval track.⁵ People participating in sprinting or military training can also experience stress fractures and muscle or tendon injuries by running on hard surfaces for extended training periods without proper orthotics.^{6,7}

The skills racing greyhounds require are speed and strength. The large muscles needed for high speed have limited insertion to bones and tendons and, as such, can have the strength of force to

rupture the relatively small tendons and origins to bones that attach to them, resulting in serious injury. Examples of common injuries in racing greyhounds include gracilis muscle and tensor fascia lata rupture.^{4,8}

Field trials and hunting

Field trial dogs also require speed and strength, but agility is important as well to navigate the unpredictable terrain. They must also be acclimated to the environment or they risk suffering from severe dehydration and heat stroke. Hunting dogs often travel long distances but need only short bouts of strength, so their training should be geared toward sprinting, keeping in mind the difficult terrain they often face.

Flyball

Flyball dogs require strength for the speedy navigation of the jumps, but they also must practice regularly to prevent injury. These dogs must be taught how to hit the platform and catch the ball in a manner that will not predispose them to chronic overuse injuries. ⁴ Teaching them a "swimmer's turn," in which they hit the platform with their forelimbs to release the ball but push off the platform with their hindlimbs to reverse direction, may prevent forelimb injury that can result from twisting and pushing off the platform with the forelimbs (*Figure 1*). ⁴

Agility

Agility dogs must be able to sprint and make sharp turns (balance) and, of course, be agile to run the course without injury. These skills require not only strength but also excellent balance and proprioception to prevent injury.

CONDITIONING AND TRAINING

Athletic conditioning requires the owner or trainer and the dog perform physical activity on a regular basis in order to be fully prepared to perform a sporting activity to the best of the dog's ability with the least likely chance of injury.⁴ This training must be tailored to the individual. And be sure to factor in a dog's breed. For example, brachiocephalic breeds do not have as much cardiopulmonary capacity as dolicocephalic breeds do, and they are more likely to develop heat stroke. ⁹

Appropriate conditioning has the potential to prevent injury, while overtraining may induce injury, and inadequate conditioning may predispose a dog to injury. In people training for long-distance running, overtraining, such as consistently running more than 40 miles a week, increases the relative risk of injury 2.88-fold.¹⁰ Researchers think that an estimated 60% of injuries in runners are due to training errors such as training erratically, overtraining, and training too frequently. ¹¹

Early conditioning

Beginning conditioning too early in a puppy may result in trauma to growth plates and could affect the puppy's immune competency. I have treated a 4-month-old Labrador retriever for severe pneumonia, lung abscess, and pyothorax. It had been training at a kennel where it was exercised two to three hours a day and housed with many other dogs. This level of activity may have affected the puppy's immunity.

In people, more than six hours a week of intense exercise doubles an athlete's risk of respiratory tract infection. ¹² That said, moderate physical activity reduces respiratory tract infection incidence in adults. ¹³ It would seem that moderation in physical activity and controlled exercise in puppies may be the safest method of training until their growth plates close.

Because closure of the long bone physes in medium to giant breeds occurs anywhere from 9 to 18 months of age, dogs should not engage in activities that are high-intensity before at least 9 months of age. ¹⁴ In addition, puppies should be socialized and allowed to play but on forgiving surfaces with good traction such as turf—not on cement or asphalt.

Play can be an excellent preparation for sports in puppies while they are still developing and can even mimic the future sport they will participate in. However, activities involving climbing (on dog walks, walls, or A-frames), continuously jumping, or short stops and starts should be avoided. For example, when retrieving a ball, dogs will make short stops and starts, which may place increased pressure on developing joints and could accelerate the development of hip osteoarthritis. Dogs predisposed to hip dysplasia that are exercised by retrieving a ball have an increased incidence of osteoarthritis of the hips.¹⁵

While there are no clear differences in abilities between male and female dogs, conditioning at the time of puberty, at least in males, may promote muscle development and, thereby, promote strength and speed.¹⁶ This type of conditioning must not involve jumping or quick, short stops and turns as described above since that could result in injury to the developing joints and bone. Conditioning in pubertal and young adult dogs regardless of sex must be controlled to prevent permanent injury since most of these dogs are highly motivated to perform until exhaustion and may not have developed their full sense of proprioception to prevent injury to tendons, ligaments, and articular cartilage. Adolescent humans are at high risk of sustaining sport injuries in part because of deficits in postural control and proprioception, and although no research on immature dogs has been performed regarding their proprioception abilities, it is possible they, too, have deficits at this time in their development.¹⁷

Frequency of training

Regular conditioning prevents loss of physical fitness (both muscle strength and endurance). Activity restriction for eight weeks causes a 41% loss of endurance in dogs and requires eight weeks of recovery to regain the original level of fitness.¹⁸

The frequency of training depends on the sport involved and whether or not endurance fitness should be a factor. Sled dogs need much more frequent training to be able to perform in competition multiple hours (and days) in a row.⁴ Flyball dogs need frequent exercise to build muscle for strength and speed but not as much as do sled dogs that perform for more than 12 hours in a day. Adequate rest is required as well as frequent training sessions to prevent injury and allow tissues to restore normal electrolyte and lactate levels to the intensely worked tissue. Serum lactate concentrations have returned to preexercise levels within four hours after agility exercise in dogs and in less than 30 minutes after a race in greyhounds.¹⁹

Regular practice greatly improves performance in dogs participating in agility competitions. In one study, even when breed, sex, age, and height were controlled for, dogs with more hours of practice were more precise as well as generally faster through a course.²⁰ Herding skill development increases with the handler's experience but is also independent of the handler and increases with practice.²¹ Even in greyhounds, training and the amount of time spent training leads to peak performance in a similar amount of time—about 9.1% of the dog's life, which is a similar amount of time spent training to peak performance in elite human track runners.²² Thus, the period of practice, training, conditioning, and development of expertise is vital for an athlete to reach peak performance. With the development of expertise, it is also likely that there is a decrease in injury as well.

Strengthening

Strengthening exercises are required for all sporting dogs as part of their conditioning program. As mentioned above, most exercise physiologists consider the term *specificity* to refer to the principle of applying exercises that will strengthen the muscles used for a particular sport and in an environment that is similar to the environment encountered in competition, whether that is sprinting or endurance running.⁴ The exercises used regularly in training will in most cases mimic the type of sport the dog is competing in, but early in the conditioning process the exercises may be less strenuous than the

exercise encountered during competition. Strengthening exercises can take on many different modalities including uphill exercise, elastic band exercise, body weights, pulling a cart, dancing, or wheelbarrowing. 4

Once a dog has developed enough skill and strength during training with the exercises, it can then be trained to exceed the work encountered during competition, which is called the *overload principle*. This principle involves the idea that in order to increase fitness and performance, the dog's muscular or cardiovascular system must exceed its current metabolic limit.⁴ By being able to perform at a greater level than what is needed during competition, the athlete will have the ability to perform well during the high stress of competition. To prevent injury, the overload principle must be used cautiously by the trainer and only after a dog has reached a level of training that is equal to the exercise performed during competition.

Endurance

The development of aerobic endurance requires sustained aerobic exercise for longer than 15 minutes at a time. With endurance training, there is an increase in oxidative enzymes to increase ATP synthesis as well as an improvement of cardiovascular efficiency; the strength of bones, muscle, and tendon; and muscle vascularization, which in turn, improves oxygen delivery.²³⁻²⁵

The long-term benefits of endurance exercise far outweigh the risks and, indeed, do not appear to increase the incidence of osteoarthritis in dogs.²⁶ Muscle development with consistent conditioning may reduce or at least slow the development of osteoarthritis.²⁷ For sporting dogs, muscle development may be important for achieving peak performance and maintaining athleticism while avoiding overuse injuries.

Proprioception

A decline in physical ability occurs with age but may be delayed by maintaining physical fitness. Part of this decline may be due to reduced proprioception with increasing age. ²⁸ Improved performance occurs with improved balance and proprioception, which reduces strain on tendons and wear on articular cartilage. Thus, any conditioning program must include balance and proprioception exercises including wobble boards (*Figure 2*), cavaletti rails, elastic bands, and figure-of-eight turns. These exercises must be performed regularly to have a lasting effect and marked improvement in fitness, balance, and proprioception.



Figure 2. A dog on a wobble board after surgery for removal of a fragmented medial coronoid process. Wobble boards are used to stimulate balance and proprioception for injured animals as well as for sports dogs during training for the development of muscle tone and coordination.

DELAYED CASTRATION OR OVARIOHYSTERECTOMY

A controversial mechanism of injury in sporting dogs is through early spay or neuter because of loss of sex hormones during growth and development. Early sterilization can result in longer leg development in dogs and an increased risk of hip dysplasia and cranial cruciate ligament injury. ²⁹⁻³¹ Delaying gonadectomy in larger breed dogs may reduce the incidence of some orthopedic diseases including hip osteoarthritis, cruciate ligament disease, and other problems related to delayed growth plate closure in sex hormone-deficient

puppies. 29,30,32 Because of these risks, I do not recommend gonadectomy before 6 months of age in sporting dogs. In all large- and giant-breed dogs, I recommend waiting to perform surgery until they are 10 to 12 months of age.

NUTRITION

Nutrition plays an important role in preventing injury in sporting dogs. Nutrition in racing greyhounds has been thoroughly researched, and much research has examined the nutrition of sled dogs as well.

Diet content

Excess caloric and calcium intake must be avoided in growing dogs since it can predispose some breeds to developmental orthopedic disease. 33 Total dietary fiber should be 3% to 7% of dry matter. 34 Sled dogs may perform better when receiving low-carbohydrate diets with up to 61% of the calories from fat, but a diet without any carbohydrates is not recommended.35 Most dogs will need 4,000 kcal metabolizable energy/kg or more, with 50% to 65% of the calories from fat and 30% to 35% of the calories from protein for high-energy sports.

Supplements

I recommend a supplement of omega-3 fatty acids such as fish oil to decrease the clinical signs of osteoarthritis and to reduce matrix metalloproteinase production in joints, which, when increased, increases the signs of osteoarthritis by degrading proteoglycans and cartilage.36,37

Supplementation with omega-3 fatty acids also results in decreased production of prostaglandin E₂, a mediator of pain and inflammation in osteoarthritis.36 Theoretically, a diet rich in omega-3 fatty acids would slow the development of osteoarthritis in athletes by reducing cartilage degradation, allowing them to compete at peak performance for longer periods. 38 Polycose (Abbott Nutrition) is a human glucose supplement that can be given to dogs in water (1.5 g/kg in 1 pint of water) within 30 minutes after an event to replenish energy stores. It should not be used if another event will be performed in less than two hours of administration since there will not be enough time to absorb the glucose source and gastrointestinal upset may result.

Dimethylglycine has not been proven to improve performance in racing greyhounds, but carnitine as a diet supplement (22 to 50 mg/kg once daily³⁹) has been shown to increase endurance in sled dogs.^{40,41} L-carnitine at a dosage of 100 mg/kg once a day may increase muscle force and delay muscle fatigue in dogs, which could reduce injury to bone and joints due to muscle fatigue. 42,43 In people, creatine can increase the capacity for sustained intense exercise, and arginine is thought to increase performance as well, but no controlled studies have been performed. 34

Timing

The timing of feeding can be critical to not only the performance of sporting dogs but to the prevention of injury as well. Discomfort from a large volume of food in the dog's stomach could result in not only reduced performance, but, theoretically, poor balance, resulting in a stumble or fall that causes injury. Feeding is not recommended during periods of strenuous exercise nor immediately before such exercise because gastric emptying is delayed during exercise.⁴⁴

A large volume of food in a dog's stomach could cause discomfort and affect performance and could increase the risk of gastric dilatation-volvulus if breeds predisposed to gastric dilatation-volvulus are exercised within two hours after feeding. 45 Mild restriction of food intake in racing greyhounds improves their running speed over dogs fed ad libitum. 46 A light meal but plenty of water for hydration is recommended. 4

Water intake

Hydration is important to prevent injury, especially in high ambient temperatures, because dehydration results in severe muscle fatigue that can result in joint and musculoskeletal injury. 47

Dogs that are not physically fit or that are weekend warriors may be prone to dehydration and its damaging effects since they have reduced muscle tone and strength.^{48,49} Be sure to remind owners and trainers of the importance of having water available at all times, even during competition, to reduce the incidence of dehydration. ⁵⁰

PRE- AND POST-ACTIVITY EXERCISE

Warm-up

Warming up before an athletic event or practice session in dogs is recommended since in some human studies a warm-up has been shown to reduce the incidence of injury. ⁵¹⁻⁵³ To increase blood flow to muscles and tendons, a warm-up requires the dog's body temperature to increase by 1 to 2 F by active muscle contraction or active range of motion exercises.⁴⁰

Lure and coursing dogs such as greyhounds are often encouraged to actively move by walking or jogging for five to 10 minutes before a race.⁴⁰ Warm-up in human athletes has reduced the incidence of injuries, specifically strains and sprains. ⁵³ For sprinting sports such as agility or flyball, I recommend 10 to 15 minutes of walking or jogging on a leash away from the event area.

Once a dog is warmed up, specific stretches including stretching the neck and passive range of motion stretching of the limbs are recommended. In people, stretching may not have any benefit in preventing injury, so some experts do not think this part of the warm-up is necessary.⁵⁴⁻⁵⁶ However, research focusing on static stretching found that holding a passive stretch for about 30 seconds with three repetitions once daily will decrease the incidence of injury.^{53,57}

Once an injury occurs, stretching of the injured area may reduce the incidence of recurrence, but strengthening exercises along with stretching may provide the best protection against reinjury. ^{58,59} So, after stretching, owners of canine athletes should have their dogs perform sit-to-stand (*Figures 3A & 3B*) and down-to-sit exercises to warm up and strengthen muscles including the quadriceps, semitendinosus, biceps femoris, gracilis, semimembranosus, and shoulder muscles (supraspinatus, infraspinatus, teres minor, biceps brachii). These exercises are also recommended on a daily basis to strengthen muscles and prevent injury.



3A & 3B. A dog and a trainer performing sit-to-stand exercise before practice. Sometimes the dogs are excited and need help performing the sitting portion of the exercise, but it is still beneficial as a warm-up.

To be effective, the practice or competition must begin within minutes of the warm-up.⁶⁰ The dogs can practice the sport right before a competition after the initial warm-up, but the exercise must be less intense (less than 70% maximal heart rate)—such as trotting and galloping but not running—and take less than 15 minutes to prevent fatigue during competition. ^{52,61} Excessive warm-up can cause increased lactate level in muscles, resulting in fatigue and increased injury rates. ⁵² Increasing lactate production by high intensity-contracting muscle will result in decreased ionized calcium release from the sarcolemma and contribute to muscle fatigue. ⁶² Muscle fatigue has been linked to

increased bone strain in dogs experimentally and may contribute to the development of stress fractures. 49,63

Cool-down

A cool-down period after strenuous exercise in sporting dogs has been recommended.

52 This period, during which the exercise intensity is between 35% and 65% maximal oxygen consumption—or moving at a walk or easy trot—for 10 to 20 minutes, is recommended to enhance muscle metabolism and shorten recovery time after exercise.^{64,65} Although no study has identified a decrease in muscle soreness or a reduction in injury due to participation in cool-down exercises after strenuous activity in people, further research in dogs and people in randomized clinical trials is still needed, and I continue to recommend a cool-down period for sporting dogs. 66

Stretching after exercise may be warranted in dogs with previous injuries because, theoretically, stretching with massage after cool-down by walking might help reduce edema and stiffness in previously injured tissues.

CONCLUSION

When owners or trainers express interest in having their dogs participate in canine sporting events, the focus for veterinarians is on preventing injury by providing advice about such factors as conditioning and nutrition. Fortunately, this focus naturally results in improved performance as well, so most goals of the trainer are also those of the veterinarian.

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