

Influences on Canine Performance

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In general, there are three negative influences on canine physical performance. They are pain, fatigue, and drive. The dog that is sound, is physically conditioned for the activity, and is properly focused on performing the task will perform better than another dog of similar genetic abilities that is deficient in any of these three areas. Our goals should be to optimize our dog's performance and at the same time minimize any detrimental affects of the workout. The better we prepare our dog for an event, the better it will perform. At the same time a properly trained dog decreases the chance of a medical problem or injury that might occur during an activity. These goals seem pretty basic when stated like this, but unfortunately those who work with any athletic or working animal knows it is not this simple. Like the human, canine performance is a result of a very complex system of chemical interactions being performed within a complex structure, driven by a minimally understood psychological force. I have found that the more we know about all of this the less overwhelming it becomes. With this in mind, the Athletic and Working Dog Newsletter will try to present information that helps to educate those individuals that own, work with, or handle a performance dog. Each issue will contain a section with information

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Temperature Regulation of the Dog

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Exercise and physical activity can create an increase in body temperature in the athletic or working dog. Sometimes this increase in body temperature can have a negative affect on performance. In extreme conditions this temperature increase can lead to a life-threatening situation. This article will look at the basics of normal and abnormal thermoregulation in the dog. A follow up article that will appear in the next issue of the Athletic and Working Dog Newsletter will look at the performance and medical aspects of managing body temperatures.

The canine athlete regulates its body temperature somewhat differently than its human or equine counterpart. The human and horse utilize sweating capabilities. The dog has minimal sweating abilities. The only site on the dog's body that has anything similar to sweat glands is located around the pads of the paw. The dog must use other mechanisms to manage its body temperature. This is why a lot of the training techniques used by the human and equine athletes are not applicable to the canine athlete. An important consideration is that the normal body can acclimate itself to many of the conditions that can induce an increase in body temperature. A proper training and conditioning program combined with the correct nutritional plan can help to minimize most increases in body temperature that are related to exercise.

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Temperature Regulation

The average body temperature of the dog is 101.5°. The normal range is between 100° - 102°. These are core temperature values and are based upon rectal thermometer readings. Temperatures can vary throughout the body, but the core temperature is used by the body to maintain

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devoted to the physiological aspects of performance, a section with information about the musculoskeletal system as it relates to the active dog, and a third section that includes various topics that include canine drive, event-related physical activity or miscellaneous information about athletic and working dogs.

Sesmooids: Little Bones that Can Cause Big Problems

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The structure of the canine paw is very complex (Figure A1). It is very similar to the human hand. The dog's dew claw is the same appendage as our thumb and is called the first digit (Digit I). The rest of the digits are the same as our fingers. They are numbered II, III, IV, and V medially to laterally. For example our index finger is the same as the dogs Digit II. The structure of the paw is made of skin, muscle, tendon, ligament, and bone tissues. Nerves stimulate how the paw functions. Most athletic injuries do not involve nervous tissue. The paw is the point of contact for the body. It is the anatomical structure that usually receives the ground reaction forces of the body. Because of this, most athletic injuries are associated with the paws.

A site of injury that is commonly overlooked involves the sesmoid structures. Sesmooids are small bones that are located at the metacarpal/phalangeal joints in the front paws and the metatarsal/phalangeal joints of the back paws (Figure A2). Their function is to help the Flexor tendons glide over the bones of these joints.

They are numbered one through eight. The sesmooids associated with Digit II are numbered 1 and 2. The numbers increase laterally so the sesmooids associated with Digit V are 7 and 8. The sesmooids are held in place by ligaments just like other synovial joints. Primary problems associated with the sesmooids include fractures, ligament strain, synovitis, tendon inflammation, tendon sheath inflammation, and puncture or trauma. A lot of times the dog will exhibit other clinical signs that require a visit to the veterinarian. Secondary problems associated with sesmoid injuries include: injuries to off leg, toes,

metacarpals, carpus, shoulder, triceps strains, trigger points, vertebral muscle strains, psychological (drive) problems, and working problems.

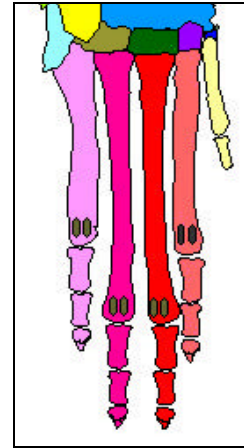


Figure A1. Boney structures of the canine digits. The dew claw is Digit I. The sesmooids are the paired small bones located at the distal metacarpal bones.

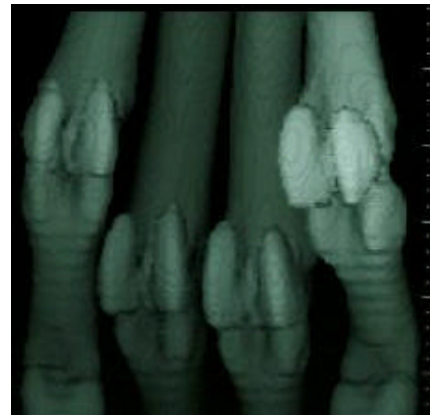


Figure A2. Picture of sesmooids recreated from a 3-D CT Scan.

The sesmooids should be checked during every lameness examination especially in athletic or working dogs. To assess sesmoid problems the metacarpal/phalangeal joint or metatarsal/phalangeal joint is flexed. Normal joints should easily be flexed to a 90° angle. Joint angles of 45° or less are indicative of a sesmoid problem. If the joint flexes at 45° but no pain is exhibited during flexion, then this is probably an old injury that is no longer a problem. If flexing the joint shows pain, then sesmoid problems should be considered as a possible source of an undiagnosed lameness.

homeostatic conditions. Because of this, the body temperature can be used to assess the physiological status of the body. The body's temperature can be affected by exogenous factors or endogenous factors. A fever caused by a bacterial infection is an example of an exogenous pyrogen. In this case the bacterial has entered from outside of the body to create the increase in temperature. A fever caused by a tumor or internal inflammation is an example of an endogenous pyrogen, where the fever is caused by an internal stimulus. This article will focus on the metabolic conditions surrounding physical activity that can cause an increase in core body temperature.

The temperature control center, or thermostat, is located in the hypothalamus area of the brain. It regulates the body's temperature based on information from temperature recognition sites located in the skin and throughout the body. These cold and hot receptors send signals to the thermostat, which initiates the mechanisms that are used to maintain the body's temperature at a functional level (Figure B1).

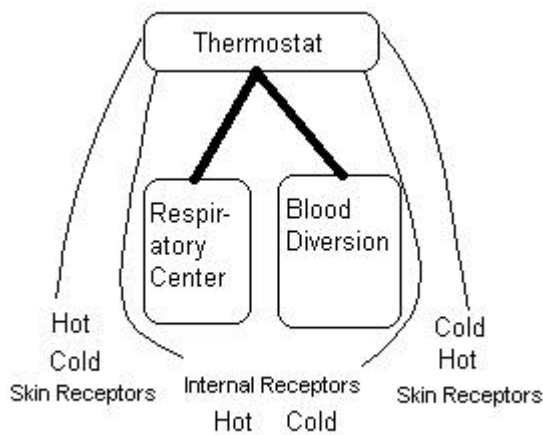


Figure B1. Thermal receptors around the body report temperature variations to the Temperature Control Center. The thermostat will then initiate regulatory mechanisms to control the body's core temperature.

The most recognized mechanism used by the dog to cool down is panting. The surface of the respiratory tract is wet and the evaporation that occurs as the air passes over the surface acts to enhance heat loss. Another metabolic mechanism used to create heat loss is altering the body's blood flow. In heat extremes, the body will divert blood

towards the surface and away from internal components. Heat is dissipated from the blood flowing at the body's skin surface. To further help with this dissipation, the dog will change its posture to enhance the surface exposure. A dog will extend its legs to increase the surface exposure when it is hot and curl up when it is cold. Another heat reducing mechanism is the brain's logical thought process. When a dog determines that it is hot it will seek out cooler locations (i.e. shade or water). It will decrease its workload and efforts. It may start laying down or sitting during the activity. It has recognized that it is hot and continuing these activities will make it hotter. The normal dog will use these mechanisms to help from overheating.

Temperature Regulation Disorders

Diagnostically, it is important to determine the cause of increased body temperature. The treatment choice will be determined by what causes the problem.

Elevated Body Temperatures

Increases in body temperature can have many causes. These causes can be environmental conditions or internal elements. Outside temperature and relative humidity are two examples of environmental causes. An elevated outdoor temperature (90° or higher) can be enough to increase the metabolic temperature. Humidity can be a factor. The dog uses respiratory surface evaporation as a means of heat dissipation and if the humidity is too high, it will reduce the evaporative capabilities. During exercise muscle activity is the main internal heat producer. Of the energy expended by the muscles, 20% - 30% is utilized for work and 70% - 80% is released as heat. This heat acts to increase the body temperature during exercise. An increase in body temperature as a result of work is a normal event that is not detrimental to the conditioned dog.

Hyperthermia versus Heatstroke

Hyperthermia is defined as a temperature higher than normal. If a dog's normal range is between 100° and 102°, then any temperature recorded higher than that would be considered hyperthermic. Most athletic or working dogs will

have an increase in body temperature to a level that would be hyperthermic. More often than not this increased temperature does not create a medical emergency. Heatstroke is a metabolic event that leads to a medical emergency. Clinical signs of heatstroke include rapid breathing and collapse. It is very common to have vomiting and diarrhea. Disseminated intravascular coagulation and cerebral edema can also occur. The oral mucosa may appear bright red and the core body temperature can be 109° or more. Heatstroke occurs when the dog's body cannot handle or manage the increased metabolic temperature. It is important to distinguish the difference in these two conditions. A body temperature that causes heatstroke in one dog may not cause any problems in another dog. Also, a dog acclimated to working at a higher body temperature won't be as susceptible to heatstroke as a dog that is not conditioned to this working situation.

It is very common to see temperatures from 102° up to 107° in dogs that are not exhibiting any signs that would be typically seen in dogs suffering from heatstroke. An increase in body temperature during activity has been reported in Racing Greyhounds, Trial Labrador Retrievers, Hunting English Pointers, and Hunting Foxhounds (Figure B2). The dog's body adapts itself to its activity level. Clinically, the normal resting body temperatures for these dogs can be 99° - 100°. This lower homeostatic body temperature is a result of the body acclimating itself to its routine activity. This information requires us to readdress how we use normal core temperature values as a diagnostic tool when working with the athletic dog.

When a dog suffers a heatstroke event during a working session we commonly evaluate the dog's body temperature. Many times it will be 102° or higher. Because normal working temperatures range from 100° – 108°, this means that the dog's thermoregulatory

system is impaired. The first action is to treat the dog, but once the event is over we should determine where the system broke down. It might be possible to fix the problem through a change in our conditioning and nutritional programs.

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| Greyhounds (Rose & Bloomberg, 1989) | 104° - 106° F |
| Labradors (Matwichuk, Taylor, ET al, 1999) | 102° - 107° F |
| Pointers (Gillette, clinical field work, 1999) | 103° - 106° F |
| Foxhounds (Gillette, clinical field work, 2001) | 100° – 103° F |

Figure B2. Reported temperatures of normal healthy dogs during activity.

Summary

In this article we have discussed the thermoregulatory system and its role in the athletic and working dog. It is important to note that working temperatures of 102° - 108° are normal during times of activity or performance. Temperatures of this level are not life threatening to healthy, conditioned dogs. A normal athletic dog will recognize when it is getting too hot and will alter its activity accordingly. The handler can use these alterations to alert them that it is time to end the workout session. If the dog is not able to handle the tasks that are required for performance, then the training, conditioning, and nutritional program of this dog should be reconsidered. Heatstroke is an event that occurs as a result of a breakdown of the thermoregulatory system. It is important to determine the cause of this breakdown so that we can determine the method of repair or treatment. Part two of this article will address how we handle thermoregulatory problems in athletic and working dogs.

Complementary references used in this Issue:

- *Textbook of Veterinary Internal Medicine, Diseases of the Dog & Cat 2nd Edition; S.J. Ettinger*
- *Textbook of Small Animal Surgery; D.H. Slatter*
- *Textbook of Medical Physiology 6th Edition; A. C. Guyton*
- *The Merck Veterinary Manual 5th Edition*
- *Canine Sports Medicine and Surgery; Bloomberg, Dee, & Taylor*
- *Miller's Anatomy of the Dog 2nd Edition; Evans & Christiaansen*