



## METABOLIC BONE DISEASE

Metabolic Bone Disease (MBD) is a blanket term that is used to refer to several disease syndromes related to abnormal calcium homeostasis, or metabolism. The cause of disease may be a lack of available calcium in the diet or it may be that for any one of a number of reasons the reptile is unable to use the calcium in the diet.

Calcium is required for more than just strong bones; it is necessary for the proper function of nerves and muscles. Calcium levels are very finely controlled within tight limits by complex hormone interactions. Bones act as a reservoir of calcium when there isn't enough available in the diet. The absorption and metabolism of calcium within the body is very complex, and varies somewhat between species of reptile. Many aspects of calcium regulation by the body remain to be determined.

A simple explanation of calcium metabolism is that when ultraviolet (UV) rays from the sun contact the skin, they activate vitamin D, which is necessary for the absorption of dietary calcium from the digestive tract. In the case of reptiles, these biochemical reactions can occur only within the animal's Preferred Optimum Temperature Zone (POTZ). The syndromes associated with MBD arise from a breakdown in this chain of events.

The cause of MBD is a husbandry problem: the diet may be low in calcium, it may contain an excess of other nutrients which prevent the absorption of calcium, the ultraviolet light source may be inadequate or the temperature at which the animal is kept may be incorrect. Some species are more or less sensitive to inadequacies at a given point in this chain. The disease manifests more quickly and severely in young and growing animals.

Signs commonly associated with MBD can be divided as those affecting the skeleton and those associated with low blood calcium. Bony problems include: swollen limbs, fractured or broken limbs (often the reptile just drags the affected limb), a fractured backbone or tail, soft shells in tortoises and turtles, a swollen or soft, pliable lower jaw and a general failure to grow. One of the most common signs of MBD, particularly in lizards such as the Green Iguana, is the inability to raise the entire body from the ground. Signs related to low blood calcium include muscle twitching, seizures, paralysis, egg binding, difficulty passing waste, gastrointestinal blockages and changes in behavior, such as lethargy or aggression. The life threatening signs described above are often preceded by more subtle physical and behavioral changes. These include a lack of energy or reluctance to posture and display in a normal manner-it is crucial to know what to expect of a normal, healthy individual of your species of reptile. Calcium is necessary for the movement of the smooth muscles of the intestinal tract, and so early signs of a problem with calcium metabolism include bloating, decreased frequency of defecation and difficulty in passing stool or constipation. In the case of the Green Iguana, it is common to see small muscle twitches or tremors in the days and weeks before seizures begin. These fine, repetitive, involuntary movements usually affect the toes and tail, and may worsen as the animal is stressed by observation or handling, or when he tries to move.



## VETERINARY CARE

### Diagnostic Tests

A detailed history and description of the reptile's environment will usually be enough to suggest a diagnosis of MBD to your reptile veterinarian. Your veterinarian will ask you about what your pet actually eats (as opposed to what he is offered), as well as about the brand name and quantity of any nutritional supplements you use, as well as the frequency with which they are used. Your vet will need to know the type of lights (particularly the ultraviolet source) and heat sources and their positions within the cage. He will want to know when the ultraviolet light was last replaced. He will also want to know the day and nighttime temperature ranges within the cage, as measured by a thermometer.

A thorough physical examination can reveal a great deal to your reptile veterinarian. He will also use the animal's general appearance, attitude, posture and muscle tone to make an initial assessment. Radiographs (X-rays) help to assess bone density and are often necessary to diagnose broken bones. It is not unusual for affected animals to have multiple fractures. Radiographs are also helpful in assessing the overall state of health. MBD is a relatively chronic or long-standing condition affecting multiple body systems. Blood tests measure calcium and phosphorus levels in the blood, as well as helping to assess kidney and liver function and electrolyte levels.

### Treatment

Treatment depends on the way in which MBD manifests, but will always begin with a revision of the reptile's dietary, lighting and temperature requirements.

Since the signs or problems associated with MBD may be only the tip of the iceberg, the animal may need to be stabilized before some concerns can be addressed. Reptiles suffering from seizures, paralysis and hypocalcaemia (low blood calcium) may need to be hospitalized for correction of fluid and electrolyte imbalances. Calcium therapy may be given by injection, orally or through dietary modification, depending on the severity of disease. Vitamin D therapy is sometimes used, but with caution. In some cases, such therapies as antibiotics, probiotics (a source of "good" bacteria) and painkillers will be used.

In the long and short term, sound nutritional support is vital for the reptile that has MBD. Animals who are very weak, who have not eaten for some time, or simply will not eat, may need to be tube fed, force-fed or otherwise assisted and encouraged to eat an appropriate diet. Initially, this might be an electrolyte solution or liquid diet until the animal is sufficiently recovered to take solid food.

## HOME CARE

Reptiles affected by MBD should be handled as little as possible, only when they need treatment. Their bones are often fragile and easily broken, and their immune systems are weakened by the stress of disease. Branches should be removed from the enclosures of animals that climb, and the enclosure should be in a low traffic area, to minimize the risk of startling the animal. Muscle weakness may increase their chances of falling. Be sure that water and food are easily accessible. These animals are often weak or in pain. Where possible, that is where temperatures are warm enough; access to natural sunlight is highly beneficial.



Medications and supplements should be given following your veterinarian's recommendations. Supplements are usually a form of calcium, without vitamin D. The frequency and quantity with which these are given may need to be modified with time consult your reptile vet.

MBD is a disease of husbandry, so close attention must be paid to your pet's environmental requirements, with particular attention to ultraviolet lighting requirements, temperature and diet. Many reptiles, particularly those affected by MBD have poor eating habits. These can take a long time to modify. Be patient and persistent. Many reptiles with MBD are not eating at all, and in such cases your veterinarian will be able to advise you as to assisted or force feeding techniques.

### PREVENTIVE CARE

In most cases, MBD will not be completely reversible, so close attention to your reptile's husbandry requirements from the beginning is always best. Most importantly, check maximum and minimum temperatures, throughout the cage with a thermometer over 24 hours; change your ultraviolet light regularly (usually every six months, particularly in the case of young, growing pets); be sure that the UV light does not shine through glass or plastic (these effectively block UV rays); constantly evaluate the composition of your pet's diet (what he actually eats); educate yourself as to the normal appearance and behavior of your species of reptile and seek veterinary attention as soon as you suspect a problem

Except in the case of carnivores, most reptiles in captivity will require a dietary supplement if they are to meet their calcium needs. Don't assume that because it is available for sale, it will work well for your pet. Determine what is best suited to your pet through research and in consultation with your reptile veterinarian, for while the addition of calcium to the diet is crucial, over-supplementation is equally dangerous. Read the labels on the supplement containers. Compare the ingredients with particular attention to the presence of vitamin D and phosphorus, as well as calcium. The type of calcium is important, and should not contain phosphorus (calcium phosphate), but a sugar (such as calcium carbonate or calcium gluconate).

Annual visits to your reptile veterinarian, including a review of husbandry practices, a physical examination and laboratory tests where appropriate are an important part of an effective preventive health program.

### SIGNS, CAUSES AND TREATMENT

The term MBD is often used loosely and interchangeably with several other syndromes related to abnormal calcium-vitamin D metabolism. Some species or individuals seem more commonly to suffer from one or two forms than from others. Factors involved include age, species, gender, reproductive status and the combination of genetics and environmental conditions.

**Secondary Nutritional Hyperparathyroidism:** emphasizes the role of malnutrition in the development of disease that leads to a poorly functioning parathyroid gland. The parathyroid gland produces hormones that regulate calcium within the body.



**Rickets:** inadequate calcification of bones in a young animal. These bones break easily, often without apparent reason, and often without the owner's knowing.

**Osteoporosis:** loss of bone density or mass in a mature animal. Osteoporotic bones are very brittle.

**Fibrous Osteodystrophy:** loss of bone mass, which is subsequently replaced by bulky fibrous tissue, in the body's effort to maintain bone strength. This is commonly seen in juvenile or young lizards, and manifests as firm, swollen limbs or a swollen, shortened lower jaw. This is because the shape of the softened bone is distorted by the pull of the muscles.

**Hypocalcaemia:** Low blood calcium has numerous effects, but is most obviously manifested as weakness, paralysis or seizures.

**Common signs of MBD in lizards:** soft or swollen lower jaw, lameness (often a broken bone), scoliosis (an "S" shaped spine) or kyphosis (a humped spine), inability to stand upright on all four legs with the body raised from the ground, dragging the body rather than walking normally, failure to grow and persistence of a juvenile appearance (such as the typical "rounded head" of the juvenile iguana) and a general "rubbery" or weak appearance.

Signs in mature lizards as a result of low blood calcium include tremors, muscle twitching, seizures, tetany (severe stiffening of the body and limbs). These signs may be intermittent, but will usually worsen in severity and increase in frequency. An episode is often triggered by an underlying condition such as kidney disease, or an increased need for calcium, as when laying eggs.

**Signs in tortoises and turtles:** in the case of young animals, the shell will fail to grow at the same rate as the body. The shell often develops an abnormal shape, with irregular scutes. In the case of young animals, the shell may fail to harden and in the case of mature animals, although they may take a relatively longer time to show signs of MBD, the shell will eventually soften, as calcium is depleted to meet the body's most immediate needs, such as nerve and muscle function. Beaks and toenails may bend and become overgrown, rather than wearing as they would when normally calcified.

MBD is uncommon in snakes (see below), but signs are similar to those seen in lizards (except broken legs).

Some species or individuals are more susceptible to shortcomings in their environments than others. Metabolism of calcium varies with species. For instance, basking lizards, such as the Green Iguana are highly dependent on intense UV light and appropriate temperatures to synthesize vitamin D, whereas a nocturnal gecko may absorb vitamin D from his diet. Not all reptiles are able to use effectively and eliminate safely vitamin D from the digestive tract, and excess supplementation of this or of calcium can greatly upset the balance within the body. The result can be abnormal, irreversible deposition of calcium within the body's organs, especially the kidneys, leading to organ damage or failure. Kidney (renal) failure is a particular problem for Green Iguanas, who are commonly diagnosed with this incurable condition after four or five years of age. Although many factors contribute to development of the condition, it is known to be directly linked to over-supplementation.



Calcium and vitamin D are present in the diets of wild reptiles in appropriate quantities. Research your pets dietary needs (see related articles). Calcium and vitamin D cannot be given to make up for inadequate UV lighting or incorrect temperatures.

Diets containing excess fat, protein or phosphorus, among other nutrients, will affect the absorption and metabolism of calcium, even if it is present in sufficient quantities in the diet. Again, see relevant husbandry articles.

Commercial diets may be deficient in calcium, high in phosphorus or vitamin D, and may contain other nutrients that negatively affect calcium balance.

**MBD is typically seen in:** herbivores (plant eaters), such as the Green Iguana who are often fed diets low in calcium and who have very precise UV and temperature requirements; insectivores, such as the Leopard Gecko, who are often fed limited diets low in calcium, such as an all-cricket diet; and omnivores, such as the Bearded Dragon, who also have precise UV and temperature needs, as well as requiring adequate calcium in the diet. True carnivores, such as snakes are less commonly seen with MBD, provided they are fed a whole animal diet, and provided that the prey is mature (i.e. the skeleton is fully mineralized with calcium). Carnivores usually receive an adequate calcium concentration and are less dependent on UV light for vitamin D metabolism. The exception may be young animals, or very small snake species, who are fed only calcium poor insects, organ meat (heart, liver, kidney) or meat containing more phosphorus than calcium (that is beef or chicken without the bone). Calcium deficiencies also result from the feeding of too many pinky or fuzzy mice, whose skeletons are not fully calcified. Supplementation may be recommended in these cases. Consult your reptile veterinarian. Without medical care and concurrent changes in husbandry, reptiles with MBD usually die. The prognosis is better when signs are relatively mild and when the animal begins treatment early in the course of the disease. The prognosis for reptiles affected by MBD is largely dependent on the commitment the owner is willing to make with respect to time, veterinary care and education regarding the animal's needs. The environmental needs of some of these animals are considerable.

Broken bones may be repaired surgically or with external splints, depending on the animal, its condition and the bone in question. Reproductive or gastrointestinal associated problems may require specific medical or surgical intervention. Seizures and paralysis related to low blood calcium are treated with injectable and then oral calcium. This form of MBD is often more difficult to treat and carries a guarded or relatively worse prognosis. A hormone called Calcitonin, which prevents the removal of calcium from bones, is used in some cases, but is generally thought to be less effective in the long term than changes in husbandry.

Disease syndromes such as scoliosis may worsen as the animal grows and ages, and can lead to complications involving the nerves of the spinal column. Reptiles whose bone structure is altered by the disease, such as lizards with a rounded lower jaw or turtles with a misshapen shell, will not usually regain normal conformation.



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Treatment is usually long term and may be life long. Follow-up veterinary visits are usually required, and may involve blood tests to assess changes in calcium and phosphorus levels and organ function, and radiographs to assess changes in bone density or fracture healing. Some individuals will have such long standing disease that recovery will require months. Some will be so severely affected that they will be unable to attain an acceptable quality of life; no matter the quality and length of care they receive. Other pet reptiles will experience such severe consequences of MBD, such as a broken back, that they cannot reasonably be treated. Some animals will be too weak to withstand potentially life saving procedures, as in cases where anesthesia is required. Individuals of certain species may be unable to cope with long-term treatment, and in light of an already stressed immune system, may fail to respond to therapy. For such individuals, euthanasia may be the only fair choice.

MBD and its consequences can have life long effects, such as compromised kidney function and stunted growth. Constant attention to the reptile's dietary and environmental needs will be necessary.