

Understanding *metabolic bone disease*

Young leopard geckos can still benefit from exposure to UV light.

As the number of reptiles kept as pets has increased, so too has the frequency of husbandry-related illnesses. Although it is easy to blame this on basic ignorance or misunderstanding of specific care requirements for particular species, the situation can be more complicated, as Andy Tedder explains.

Firstly, there are certain species which are particularly vulnerable to these health problems, and also specific groups within a species, such as young or breeding animals which are at greater risk. The problem itself may be complex too, as typified by metabolic bone disease (MBD). Its name suggests a single cause, but in reality, this is something of an umbrella term, and its complex nature may help in part to explain the prevalence of cases of this nutritional disease.

Put simply, MBD refers to skeletal abnormalities caused by calcium (Ca) deficiency. Ok, so why is calcium so important, and what exactly does it do within the body? Calcium is responsible for a large number of processes within the body, including:

- Growth and maintenance of calcified structures like teeth and the skeleton;
- Muscle contraction in various types of muscle tissue including the heart;
- Nerve impulse conduction, both to and from the brain and spinal cord;
- Blood coagulation;
- Cellular movement.



The weight of the tongue can cause distortion of the lower jaw in cases of MBD.

What is quite clear from this list is that calcium does have a very significant role to play within the body, and that a deficiency can have profound, far-reaching effects, that perhaps many people did not realise.

1. Metabolic bone disease caused by excessive phosphorus.

Generally speaking, reptile metabolism favours a calcium: phosphorus (Ca:P) ratio of equal to or greater than 2:1. When the diet contains too much phosphorus relative to the calcium content, then the body will take measures to readdress the balance. Calcium will be taken from various sources throughout the body starting with blood plasma, and then calcified tissue, particularly bone, with this process being triggered by hormones.

What it is important to note is that unless the calcium is replaced, the tissue from which it was removed will remain deficient in this vital mineral, with the bones for example becoming weaker and gaining a rubbery texture. Calcium stripped from the skeleton passes into blood plasma and other tissue fluids, before eventually being lost through the urine, worsening the situation. Firm evidence about timescales for this process at present do not exist, and this of course makes it difficult for keeper to address.

Early symptoms of this form of MBD include:

- Swelling of the limbs; this is particularly evident in crested geckos (*Rhacodactylus ciliatus*)
- Disfiguration of the lower jaw. Interestingly both the upper and the lower jaw will suffer the same rate of bone softening. However, due to the force exerted by the musculature of the tongue, the lower jaw develops the characteristic bowed shape.

In extreme cases, other symptoms can include;

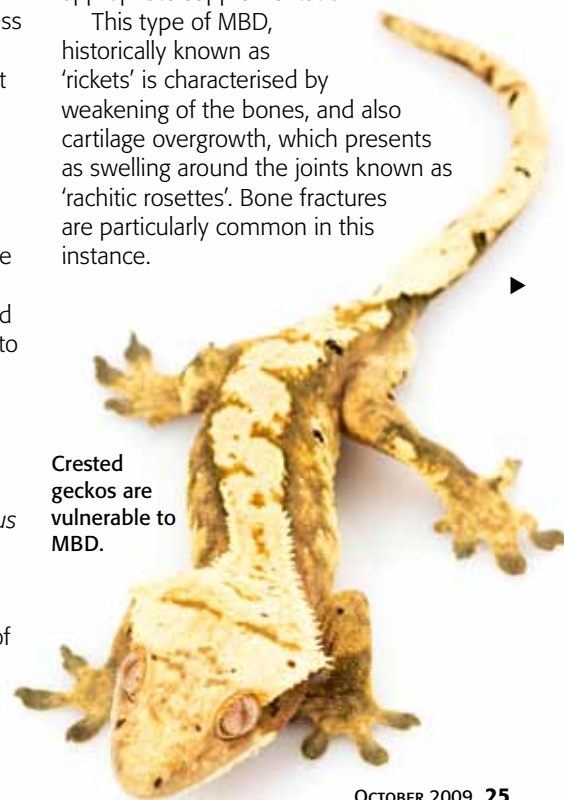
- Muscular spasms
- Twitching
- Paralysis

2. Metabolic bone disease caused by insufficient vitamin D₃.

It comes as a surprise to some owners that reptiles with sufficient dietary calcium can still suffer from MBD. The reason for this is the lack of either dietary or environmental vitamin D₃. This vitamin is essential for calcium absorption via the intestines, and is generally synthesised by animals when exposed to sunlight or artificial UV light. Nocturnal animals also need a source of vitamin D₃, and this is usually supplied by appropriate supplementation.

This type of MBD, historically known as 'rickets' is characterised by weakening of the bones, and also cartilage overgrowth, which presents as swelling around the joints known as 'rachitic rosettes'. Bone fractures are particularly common in this instance.

Crested geckos are vulnerable to MBD.



3. Soft tissue mineralization caused by excessive Vitamin D₃ and excessive calcium.

Although it is clear that reptiles require both an external source of calcium and external source of vitamin D₃ to remain healthy, 'more' is not always better. When an excess of both calcium and vitamin D₃ are present in the system, the animal can develop soft tissue damage. The problem occurs because the blood calcium level rises to such an extent that deposition of calcium into muscle tissue begins. This condition is known as hypercalcemia. The range of organs and tissue which this condition affects makes it very dangerous, with key organs such as the heart, lungs, kidneys and bladder being amongst the most common, as well as major blood vessels.

What becomes apparent is that both calcium and vitamin D₃ play a vital role in the health and well-being of your animal, and that an appropriate balance must be achieved to maintain not only healthy bone growth, but also to prevent calcification of muscle tissue. With this in mind, the diet of each reptile species becomes very important.

Ca: P – getting the balance right.

Correct nutrition can mean the difference between a healthy or sick animal. All reptiles have the potential to suffer from any of the forms of MBD, and so ensuring the necessary dietary components are present is very important. Table 1 shows the ratio of calcium: phosphorus in some commonly-offered fruits and vegetables. What is significant here is that this table affects both insectivorous reptiles and herbivorous reptiles, as correct gut-loading of insects is very important, being influenced by the foods they are being offered.

Table 1. Foods and fruits along with their calcium: phosphorus values.

Negative Vegetable	Ca:P	Positive Vegetable	Ca:P
Banana	1:3	Broccoli leaves	4:1
Broccoli florets	1:1.6	Broccoli stems	2.5:1
Brussel sprouts	1:4.5	Cabbage	6:1
Cucumber	1:2	Chard	6:1
Grapes	1:2	Collard greens	2.75:1
Lettuce	1:2.5	Dandelions	2.5:1
Mushrooms	1:7	Kale	3:1
Tomatoes	1:2.5	Mustard greens	3.5:1
Corn	1:13	Watercress	3.5:1

From the table, it is quite clear that some vegetables are better than others, and perhaps some should be avoided altogether. The key as ever is in balance, particularly as some of the brassicas such as kale, with a high Ca:P ratio nevertheless have other nutritional shortcomings, which restrict their usefulness as reptile food.

UV light and dietary vitamin D₃

The role of vitamin D₃ as both a preventative and yet also potentially a cause of the various forms of MBD means that correct dosage is essential. The exact method by which you provide this for your animals will vary depending on its other husbandry requirements. For example, a diurnal reptile such as a tortoise or iguana will require a source of UV light, and so its additional dietary vitamin D₃ requirement will be lower (relatively) than that of a leopard gecko or other nocturnal species.

Are certain groups or species more at risk?

While all types of reptiles can be at risk from MBD, breeding females of all egg-bearing (oviparous) species are especially vulnerable. The calcium requirement of breeding females is much greater than that

of males of a similar age, due to the calcium required for their eggs. For this reason, it is usually recommended to adapt your feeding and supplementation regimen to compensate accordingly.

Other 'at risk' groups include species which have a particularly fast-growing juvenile stage like Chinese water dragons (*Physignathus cocincinus*). Crested geckos (*Rhacodactylus ciliatus*) also deserve a special mention. They appear to be unusually susceptible to MBD, especially when kept on a diet primarily consisting of insects. Although this species is nocturnal, it is for this reason that I would suggest the use of a low level UV bulb (2 per cent UVB) for a couple of hours daily.

What to do if you suspect your animal is suffering with MBD.

Unfortunately, MBD is becoming quite common, and the early signs can be tricky to spot unless you know what you are looking for. If in doubt, always consult a reptile vet, they will be able to evaluate the situation fully in an individual case, and, taking into account both the symptoms of the animal and husbandry details, they will be able to help you make improvements.

MBD is treatable in most cases, but unfortunately, its effects are often irreversible. This means that if your animal is presenting quite severe symptoms such as a bowed jaw, this will not revert to its original state, but it will be prevented from getting any worse. Early diagnosis of the problem is therefore very important in the longer term.

The best advice I can give to anybody with concerns is to read as much information about their captive husbandry as you can, talk to breeders and fellow enthusiasts. Providing the right nutrition and conditions for your animal really is key to ensuring its health.

*Andy Tedder is an enthusiastic breeder of geckos, and fully conversant with the risks of MBD. You can find his website at www.glasgowgecko.co.uk



Important!

Check the output of your UV bulbs frequently. A UV tube will become less effective over time, without appearing so visually. A good rule of thumb would be a tube without a reflector will have a lifespan of between 6-8 months. A tube with a reflector will have a lifespan of 12-15 months.

Water dragon juveniles are fast-growing, making them susceptible to MBD.