Hip Dysplasia

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Joint Disease and Rapid Growth
Many of the joint diseases that occur in the younger dog can arise as a consequence of rapid growth in an increasingly heavy breed of dog (over time).

Osteochondrosis and joint dysplasias have been studied in many species, in particular in pigs. In pigs, where the animals were selected for an increasingly heavy end weight and for rapidity of weight gain, the incidence of symmetrical lesions in joints and many growth plates. Experimentally in pigs, the incidence and severity of OCD was ***directly related to rapid growth*** ie. rate of weight gain. When the diet was restricted and they were grown at a slow growth rate, the incidence of OCD was dramatically reduced (almost to zero).

All dog studies in this area support the concept that high caloric intake rather, than the specific intake of protein, minerals or vitamins, influences the frequency and severity of osteochondrosis and HD. The causes of ED while not as thoroughly studied, show similarities and probably similar outcomes.

The common conclusion from studies on dogs is that excessive calcium, phosphorus and vitamin D along with a high energy diet and rapid weight gain causing rapid growth, are almost a sure fire recipe for pushing the parameters for normal structural growth and joint soundness well beyond their normal limits, resulting in joint disorders.

The higher incidence of osteochondrosis in males versus females is probably a direct reflection of this as males can be 15-25% heavier than females at any one time, despite being born at a comparable weight.

Equally, this is not to say that genetics does not pay an important part in the body's structural soundness. Excessive rates of weight gain and thus rapid growth result in pushing the body's parameters beyond which they can cope, particularly if they were not the most structurally stable to start with. For example, an excessive rate of growth and weight will not create severe HD in itself but it can make an existing problem considerably worse.

Rate of Weight Gain

Rapid weight gain and rate of growth through excessive nutritional intake may cause a disparity of development of supporting tissues.

Factors affecting cartilage integrity (thickness and stability) and joint fluid composition, such as repeated trauma from excessive looseness of the joint, can increase joint fluid production, thickening of the joint capsule, resulting in both joint pain and reduction in joint stability. These factors contribute to the development of joint looseness and subsequent subluxation, resulting in early clinical signs and joint changes.

Control of the rate of weight gain particularly with HD
While a slow rate of weight gain will not prevent hip dysplasia, it will create a steady growth pattern allowing the hip structure to mature in concert with the strength of ligamentation, which will minimise excessive stress being placed on the hip joint.

Conversely to osteochondrosis, females in any breed with HD generally have a slightly higher average than males. This is thought to be due to the influence of female's hormones.

Dysplasia ***is a term that technically means poor or abnormal formation.***
"Joint dysplasia could be considered to be the result of an imbalance between weight bearing forces and the maturation of cartilage to bone. If cartilage can convert to bone to form normal shaped articular (joint) surfaces prior to abnormal stresses being placed on the joint, dysplasia can be avoided.
However, if the cartilage model becomes malformed prior to the final conversion to bone, the joint will be dysplastic. The severity of each form of dysplasia varies, creating disease with differing clinical significance." (JP Morgan et al 1999).

Hip Dysplasia (HD)

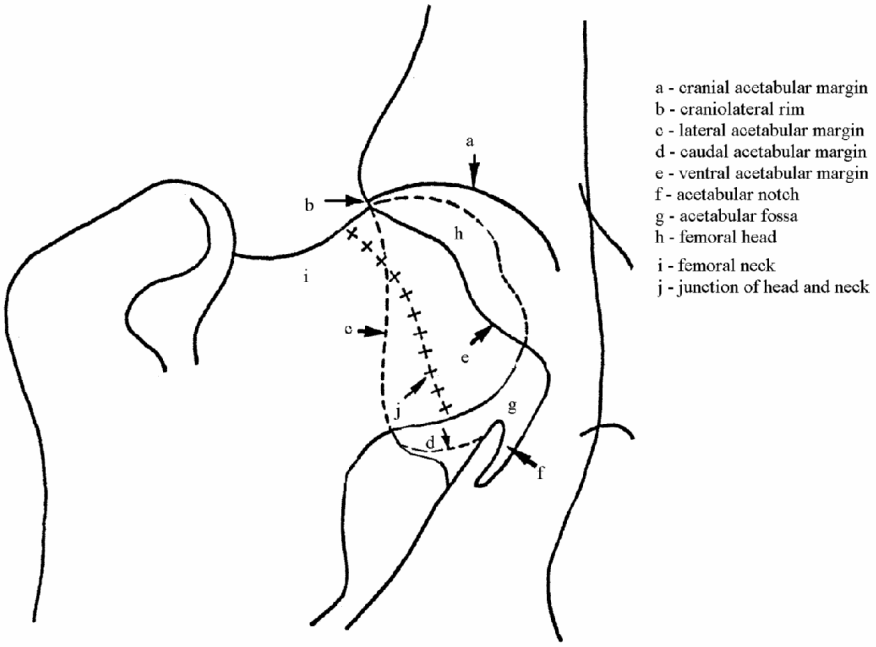
This is a condition that is very common throughout the whole range of dog breeds from the very small to the giant breeds. It is more commonly seen in the heavier bone to muscle ratio breeds where the overall ligamentation is loose.
Hip dysplasia, is by definition, an ill fitting hip. The hip is a ball and socket joint, where the deeper the socket (ideally sufficiently deep to hold 2/3rds of the head of the femur), the better fit of the femoral head to the socket, combined with tight ligaments, the better the hip.

The various components that <u>combine</u> to give an unstable hip are combinations of the following:-

i. shallow hip socket (the acetabulum),
ii. an ill fitting head of the femur (head too small, neck too short and steep)
iii. excessive looseness of ligamentation.

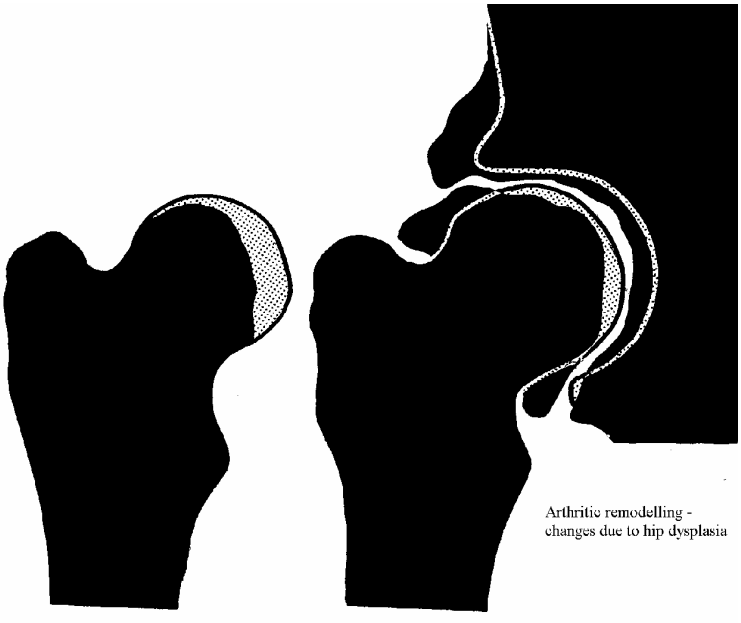
A combination of the above factors lead to instability of the joint.

The joint capsule is attached around the outer edges of the joint and to the periosteum. When the edges of the joint capsule are constantly being pulled, the periosteum is lifted and new bone is laid down in an attempt to stabilise the joint.
Diagram - Normal Hip



Anatomical Points of the hip.

Diagram - Arthritic changes over time in the hip



Pain from hip dysplasia is largely from the wearing of the cartilaginous surface within the joint, exposing pain fibres in subchondral bone. There are two groups of animals affected:

1. Young group – 4.5 -10months (rapid growth phase)
2. Older patients with chronic degenerative disease.

 # HD rarely, if ever, presents as a sudden acute injury or onset. It is chronic in nature.

Examination for HD

Symptoms - Dogs with HD have a history of intermittent hindquarter lameness, pain on rising, poor hindquarter muscle development, narrow hindquarter action, reduced arc of movement and reduced exercise tolerance. An examination under anaesethic may show looseness but X rays will, if correctly positioned, give a more definitive view of the anatomical details as well as arthritic changes and the degree of joint looseness.

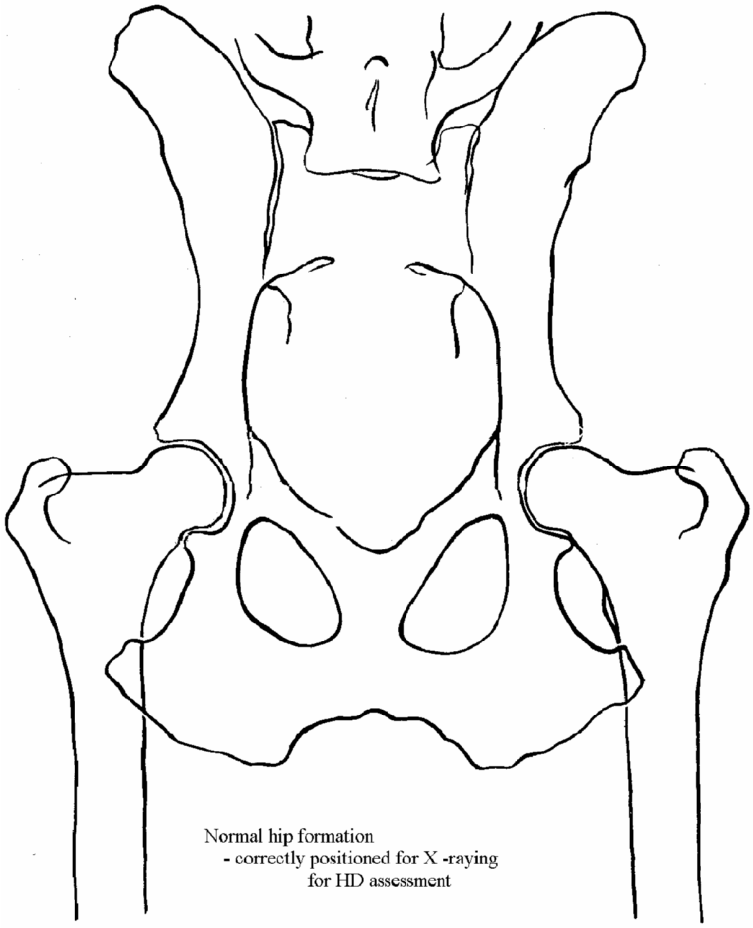
It should be remembered younger, overweight dogs will be looser in ligamentation than older, fitter individuals. Different anaesethic agents and depths of anaesthesia can slightly vary the degree of looseness of ligamentation seen.

Heavier, larger and looser ligamented breeds (and individuals) will exhibit the greatest arthritic changes. Some breeds tolerate looseness better than others.

 # Clinical signs often <u>do not</u> correlate with radiographic changes. Some dogs with moderate or even severe HD are asymptomatic.

Positioning for X rays for HD assessment – It is most important that of the pelvis be level, both from front to rear, and side to side. Too steep an angle of the pelvis front to rear will give the appearance of a shallower joint. A twisted, crooked pelvis side to side will have adverse effects as the hip will be tilted further away from the X ray plate.

Diagram. - Normal hips, well positioned for HD Xrays.



Differential Diagnosis –
In both groups of affected dogs (young and old) but particularly in the younger group, the back should be assessed, especially when accompanied by generalized soreness from excessively rapid growth. Soreness along the back, usually obvious by arching along the middle (lumbar section), will affect the dog in both rising and extension during movement and manipulation.

In the younger dog, rule out lameness from other rapid growth associated conditions eg. Panosteitis, OCD, HOD or other injury to joints in the hindquarters. In the older dog, conditions such as cauda equina (neurological), acute or chronic knee injuries, bone neoplasia need to be considered.

Methods of Treatment of HD

Treatment depends on the age of the patient and the severity of the symptoms, physical and radiographic findings and economics of the owner. Conservative and surgical options should both be looked at.

Many younger dogs (60%) spontaneously improve with increasing age after conservative management and return to acceptable clinical function (Barr, Denny, Gibbs 1987). The remainder require further medical or surgical treatment at some time in their life.

Surgical intervention is indicated where conservative treatment is not effective, where athletic performance is desired or in young patients where owners wish to slow the progression of degenerative joint disease and enhance the probability of good long term limb function.(Small Animal Surgery 1997).

Medical Management

1.The younger patient will need rest, correction of diet and weight if needed, use of drugs such as cartrophen to improve circulation to, and repair of cartilage and the use of other anti-inflammatory drugs. Rest and recuperation for as short as 2-3 weeks can lead to remarkable improvements.

2.The older patients – Again weight should be considered as too heavy in condition will acerbate wear in all the joints, not just the hips. Again use of the same drugs as above can give remarkable results. Rest with severe cases is always advised.

Non steroidal drugs include Previcox*, Rimadyl* (carprofen), Metacam*, Aspirin, PBZ (phenylbutazone) and Cu Algesic*.

If dogs in either group fail to respond to appropriate treatment, dietary changes and rest, then surgical intervention may be necessary.

Surgical Intervention

1. Pectinomyotomy is the mildest (also cheapest and quickest) way to get some relief for the HD patient. This was used quite frequently in the past when there were fewer options were available. This muscle cutting operation transects the pectinius muscle, a muscle which runs high on the inside of the thigh and pulls the leg medially. Cutting this muscle relieves tension on the joint capsule and eases movement by reducing medial pull of the limb. This can be very useful in the younger patient, particularly where funds do not permit the more radical operations. In can provide good pain reduction, and does not interfere with any other surgical option at a later date.
2. Triple pelvic osteotomy is ideally done on dogs before they reach 9 months of age, before the pelvis has finished growing. This is done to axially rotate and lateralize the acetabulum in order to increase the dorsal coverage to the femoral head. This operation is not suitable where there is insufficient depth of acetabulum to hold the femoral head. The results are best where there is minimal degenerative change. Generally both hips are done at once, at a cost of around $6000.
3. Total Hip replacement is the replacement of a degenerative hip joint with a prosthetic acetabular cup and a femoral head/neck component. This is used on the older patient where conservative treatment is not effective. Hip replacements are performed by orthopaedic specialists and the success rate is good to excellent. This is usually not done much on breeds or individuals that weight less than 20kg as it is very hard to get small enough prosthetics at this time. The cost per hip is $3000 and up.
4. Femoral head and neck excision limits the boney contact between the acetabulum and the femur and a fibrous joint is formed. This type of operation is routinely used for dislocations of the hip from trauma and in the case of HD dogs where conservative treatment has failed and there are financial constraints against a total hip replacement. The results are no where near as good as with (3), as there are fibrous changes and restrictions of movement. This is largely seen as a salvage procedure. However, many dogs do very well and have improved function. It must be noted that once this operation has been done, other surgical options are virtually nil.

Discussion

Given the very high percentage of younger dogs that respond to rest, conservative treatment and weight/dietary management (60%), the first route of treatment should ideally be conservative, medical management. Many breeds are quite loose in their ligamentation when young and if weight factors are above breed norms for that age and sex, conservative treatment with calorie limitation should be tried. Unless there are substantial abnormalities present, ie. very shallow sockets, excessive luxation of the joint with arthritic changes developing and significant pain that is unresponsive, conservative treatment should be tried. If there are significant changes that are unresponsive to rest and treatment within the short term, then surgical options must be considered.

Older dogs should be tried on conservative management first and, again, if not responsive, surgical options should be considered. The best responses are from total hip replacement, but the cost is high. If this cannot be afforded, the age of the dog should be considered, the older the dog, the more one leans to medical management. For the younger the dog with severe symptoms a surgical option should be considered.

Any significant surgical option for hip dysplasia should be viewed from the view of the whole dog's age, health ***and other existing conditions****.* A dog with severe elbow dysplasia and bad hips should be managed medically. The older the dog, the more likely one would opt for conservative medical management. Younger dogs with just bad hip(s) but sound elsewhere would, on the other hand, be good candidates for surgical intervention if financially viable for the owners.

Schemes to reduce the severity and Incidence of HD/ED

The major task in reducing the severity and or incidence of any breed inherited disorder, is establishing the mode of inheritance Most inherited problems have two or more genes affecting the inheritance pattern and not all genes behave nicely ie. dominant genes can express a problem or hide another problem eg. coat colour. Other genes can behave incompletely, ie. blend effects with a normal gene and not be expressed, as the normal gene carries sufficient enzyme making ability to hide the effects of a defective gene. The animal will appear normal but is in fact a "carrier" of the abnormal gene.
The more genes affecting a characteristic, the harder and slower it is to eradicate or affect the characteristic and the more environmental effects may come into play (weight, diet, rate of growth etc). Where there are ways to **measure** the effect of the characteristic, then progress can be made in controlling the effect of the polygenes in the overall population eg. Hip Dysplasia - X raying of individuals and their progeny.

The schemes currently in use for control/reduction in severity of HD and ED aim to reduce the incidence and overall severity of these conditions across a breed a) as a whole and b) over time. Trying to shift the genetic structure of polygentic conditions within a breed is a long term goal and cannot be pushed rapidly without severe consequences in other areas (eg. type, temperament etc).

The overall picture must be considered. Trying to eliminate all dogs with hip dysplasia did not work (attempted in both GSD's and Labradors). The end result was a greatly reduced genetic pool, cases of HD still occurring and breeds that did not resemble the standard. *The main aim today of most hip schemes is a gradual reduction in the breed average while at the same time allowing breeders to preserve valuable bloodlines and to decrease the incidence of severe HD.*
The hereditability of HD varies in different breeds, the higher the degree of inheritance, the more rapidly changes can occur within a breed when selecting for that characteristic. Also, a dog that has a good hip score, may not necessarily throw low scores in his progeny, while a full litter brother with a similar score may have a far lower progeny average than his brother.
Until there are very reliable breed specific DNA markers or gene tests, rapid change within breeds, and therefore breed averages, will not be possible.

HD X-Ray Control Schemes
Grading – Various aspects of hip construction and looseness of joints are looked at and assessed. The current international grading system has 0-6 grades, also called A-F (in some countries). The worst grade per hip gives the overall grade (ie. if grade 0 in 1 hip and 3 in the other, the overall grade is 3).
Scoring – Using the BVA System, 9 different areas of the hips are measured and scored (generally out of a 0-6 scale). The total score per hip is given as well as overall total (maximum 106). This is very useful in determining the breed average. If combined with a grading system, again the hip with the highest score will determine the overall grade (the ED scheme works on a similar score/overall grade basis).The Australian 'A' Stamp is given by the GSDCA for hips that have a total score of 8 or less per hip. These scores are considered within normal limits of the breed and suitable for breeding purposes.
PENN Hip – Dogs are anaesthetised and subjected to standard pressure, then X-rayed, to determine the degree of joint laxity. Many breeds exhibit varying degrees of joint laxity both across the breed and within the breed. The relevance of the joint laxity when done at an early age (4-6 months) needs to be seen relative to long term hip results (ie. against standardised HD X-rays at 12-18 months of age. Some breeds are more "laxity tolerant" ie. the rate of change predicted is not as high in some breeds as others.

Breed Averages
Breed average is determined by adding all the scores from all the submitted animals and then dividing by the number of dogs. An average member of a breed being checked for that characteristic (HD) will probably have a result (score or grade) close to that average score.
Breed median – A breed median is the result for that breed where 50% of the breed will be better than that figure and 50% will be worse. In breeds where there are smaller populations being scored, the breed average may be considerably higher than the breed median. With increasing numbers (thousands) these figures are considerably closer.
With HD Schemes, we are working with empirical tests with large degrees of variability. It is therefore essential that every breed be looked at from as broad a spectrum as possible so that a relevant decision can be made as to the breed worth of that individual. As we discussed above, when looking at a population, the spread of the population as well as the population mean is essential if making decisions as to what one can afford to discard from that population. Combined with this we need to estimate how many other individuals are being culled for various other reasons. In looking at a breed population as a whole, ***we need to retain at least 75% of the population for any one characteristic being selected for***.

Importance of breed median – A breed median is the result for that breed where 50% of the breed will be better than that figure and 50% will be worse. When breeding we obviously wish to breed from the best and soundest dogs, but as stated before, this should be kept in perspective in relation to other genetic and breed soundness characteristics that are necessary. For that reason, we generally breed upto and often slightly past a breed average if we wish to retain sufficient breeding stock for the overall health and viability of the breed.

Rolling Breed Averages
When discussing HD in the GSD, the cumulative breed average (total score) is somewhere around 13.14 in Australia (after some 20,000 dogs have been scored/graded) versus the UK average of around 18. If however, rather than looking at an accumulated average over 20 years we look at the breed average for the last 5 years in Australia (over some 4,500-5000 dogs screened), then our current average (2005) is considerably lower at 9.38. This shows how effective these schemes can be if used properly.
In Australia a maximum of 8 per hip is allowed by our national governing body the GSDCA, with no more than 3 points in any one area. An 'A' stamp is issued for those dogs which pass, indicating that the overall quality of the hips is suitable for breeding. As the total score per hip can go to a maximum of 53, a cut off of 8 per hip is quite low.

Hereditability of HD
In the GSD as the heritability of HD is quite high, therefore reasonably rapid improvements can be made. Generally 75% of the dogs submitted will pass these stringent requirements, indicating that the spread of the population is reasonably narrow.
In other breeds, if one looks at the 75% of the population one wishes to keep, the breed average may be much higher, the inheritance lower and the population spread much greater.
For example in the Golden Retriever, their breed average was around 20-22 some 30years ago, then gradually lowered to around 15.5 about 10 years ago. This mean then appeared to shift very little in the last 10 years despite hard work by breeders. However, by developing rolling (every 3-5 years) breed averages will give a truer picture of what is currently happening versus the accumulated data of 30 years. Recently this was done and the current average is actually sitting around 11.5.

Correct use of the Inherited Diseases Schemes by Breeders

The whole idea of these schemes is to give breeders information so as to give them knowledge prior to breeding an animal as to what one <u>can</u> afford to do.

BVA Scoring Scheme - Obviously an animal with a relatively high score should be used with more care and ideally to a partner with a low score/grade and preferably where there are known family or sire averages. This type of system works particularly well for selecting good hip producing sires where the sire statistics are accumulated and published.
The average score of the sire's progeny (where more than 20 progeny are scored) is of greater benefit in predicting the genetic worth of the dog than it is the score of the sire himself. *Sires with more than 20 progeny scored that have with breed averages of less than 10 are highly desirable.*

The conclusion one gets from these schemes, is that the more information one has for both of the parents and of their close relatives, particularly offspring of the sire, the better one can plan and get successful results across a litter. In breeds where such information is limited and/or sire statistics are not available, breeders have a much harder time selecting good sires and good breeding combinations.

Breed Averages for the Australian Cattledog
The Willis scores show (up to early 2004) some 50 odd dogs screened in the UK for an average of 11.0 , range 6-23.
The Willis scores for in Australia from around 250 scored (including NZ dogs) a cumulative average of 10.78, and ranging from 0-38.
The figures are fairly consistent between the countries.

What we need to do is develop rolling breed averages to determine the "current" breed average for the Australian Cattle dog. By knowing the current breed average it gives breeders a line in the sand as it were for what is the true average in the breed. Once this is known, breeders can make their own minds up as to what they can ***afford*** to breed with.
Generally one would like to retain ¾ of all breeding stock, ie. basically remove the worst dogs from breeding. Over time as the breed average lowers, one begins to get more predictability in breeding.

While on the subject of health testing, you should be screening for elbow dysplasia as well. Breeds that are over 20kgs as adults and heavy in the bone are very prone to OCD and elbow dysplasia. It is very easy when getting the dog X rayed for hips to flip it around and get the elbows X rayed at the same time. Improving one end and ignoring the other ultimately can only bring grief.

The Cattle dog is heavy in the front end, and being a dog that relies on its ability to shift weight quickly in the front end, darting and weaving around cattle, the front end bears much of the brunt of any injuries. As a veterinarian I see many older dogs with quite severe arthritis in the forequarter, particularly in the elbows. OCD can and does affect your breed significantly in the elbows predominantly and to a lesser extent the shoulders. Recovery from shoulder surgery is usually excellent. Elbows being an arrangement of 3 bones that must line up precisely to form a congruent joint, where this does not occur, significant and life long damage results. At least 33% of elbows scored have arthritis.

Luckily for your breed, OCD is rarely seen in the hocks, where it does occur the effects would totally cripple the dog as a working animal. Slipping patellas do occur, particularly in the straighter hindquartered animals. Slipping patellas are as a result of 3 different factors – straight rear end, shallow grove on the femur where the patella slides as the knee moves and loose ligamentation. Certainly dogs with slipping patellas are unsuitable as working dogs, particularly for the darting and weaving required to keep cattle on the move.

The lead in section to this article is to push home the fact that while these conditions are genetic in origin, the severity of both hip and elbow dysplasia can be acerbated by rapid growth and weight gain. Ideally what breed clubs should do is develop a weight for age chart for both males and females covering 6 weeks to say 10-12 months. There generally is a range of weights that are normal, but while breeders generally keep the weights within normal ranges, pet people often vastly over feed with quite often disastrous results.

Summary

Breed health schemes should always be looked at as long term projects. To alter the whole genetic make up of the breed takes generations. The more diseases one tries to improve at the same time, the slower the progress. With many breeds there are now obvious improvements in breed averages for hips, German Shepherds, Rottweilers, Labradors and Golden Retrievers to name a few. All the old and current hip data has now been electronically loaded and is in the process of being analysed. I will try and get current data to your Club as soon as possible.

We as breeders are generally only in our breed for 10-15 years on average, some may have the strength to do their 20 years (been there, got the scars!), but we are the guardians of our breeds. We should, like physicians, do no harm, rather we should leave our breeds in a healthier state that when we entered them. If dogs are to survive in this increasingly busy world, those that are the healthiest and easiest to care for will survive the best.

Failure to make efforts to control known diseases within our breeds where there is a means to do so, leaves all of us open to litigation.