Hip and Elbow Dysplasia in the Golden Retriever in Australia.

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Hip Dysplasia

- 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 combine to give an unstable hip are combinations of the following:-

  -shallow hip socket (the acetabulum),

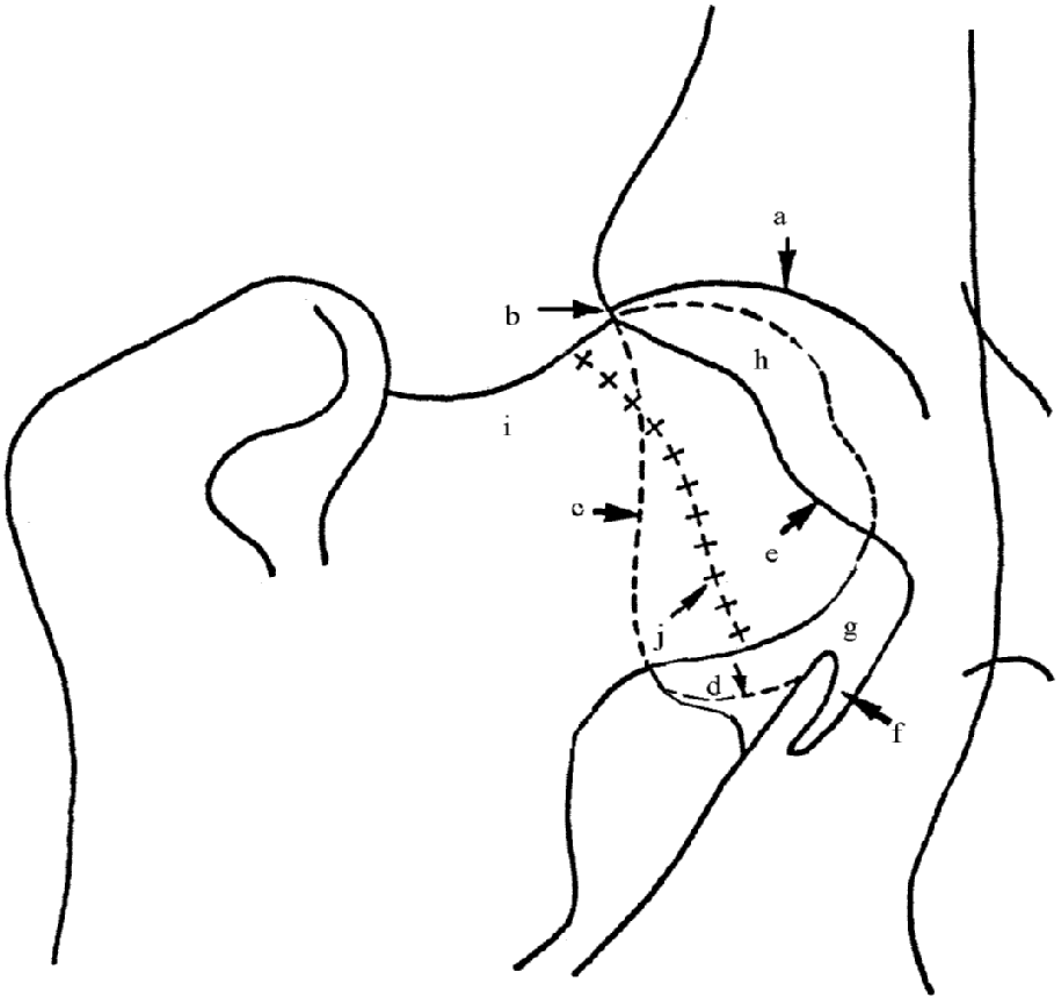
  -an ill fitting head of the femur (head too small, neck too short and steep)

  -excessive looseness of ligamentation.

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

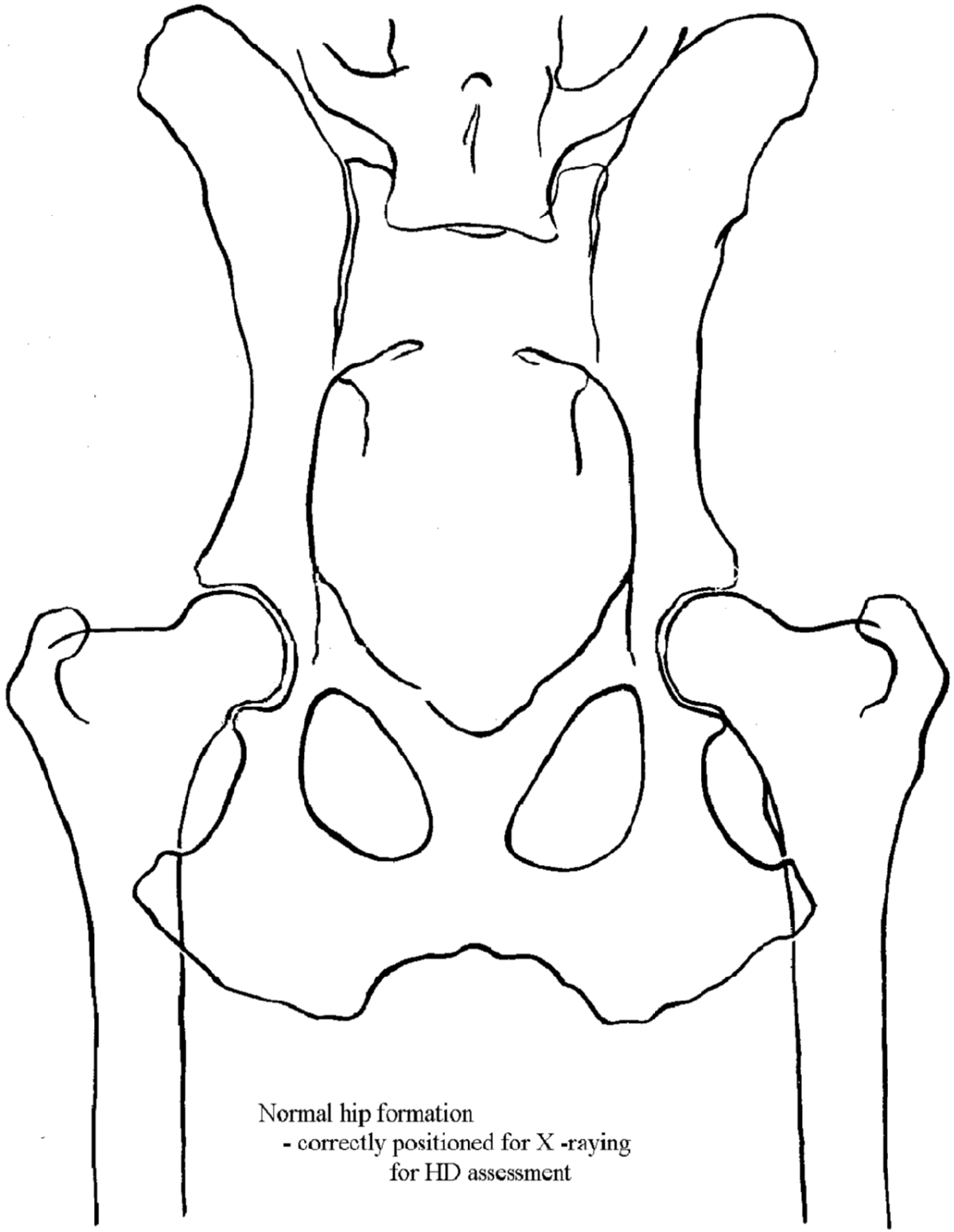
- The joint capsule is attached around the outer edges of the joint and to the periosteum. When the edges of the joint capsule are constantly being pulled, the periosteum is lifted and new bone is laid down in an attempt to stabilise the joint.

Diagram - Normal Hip



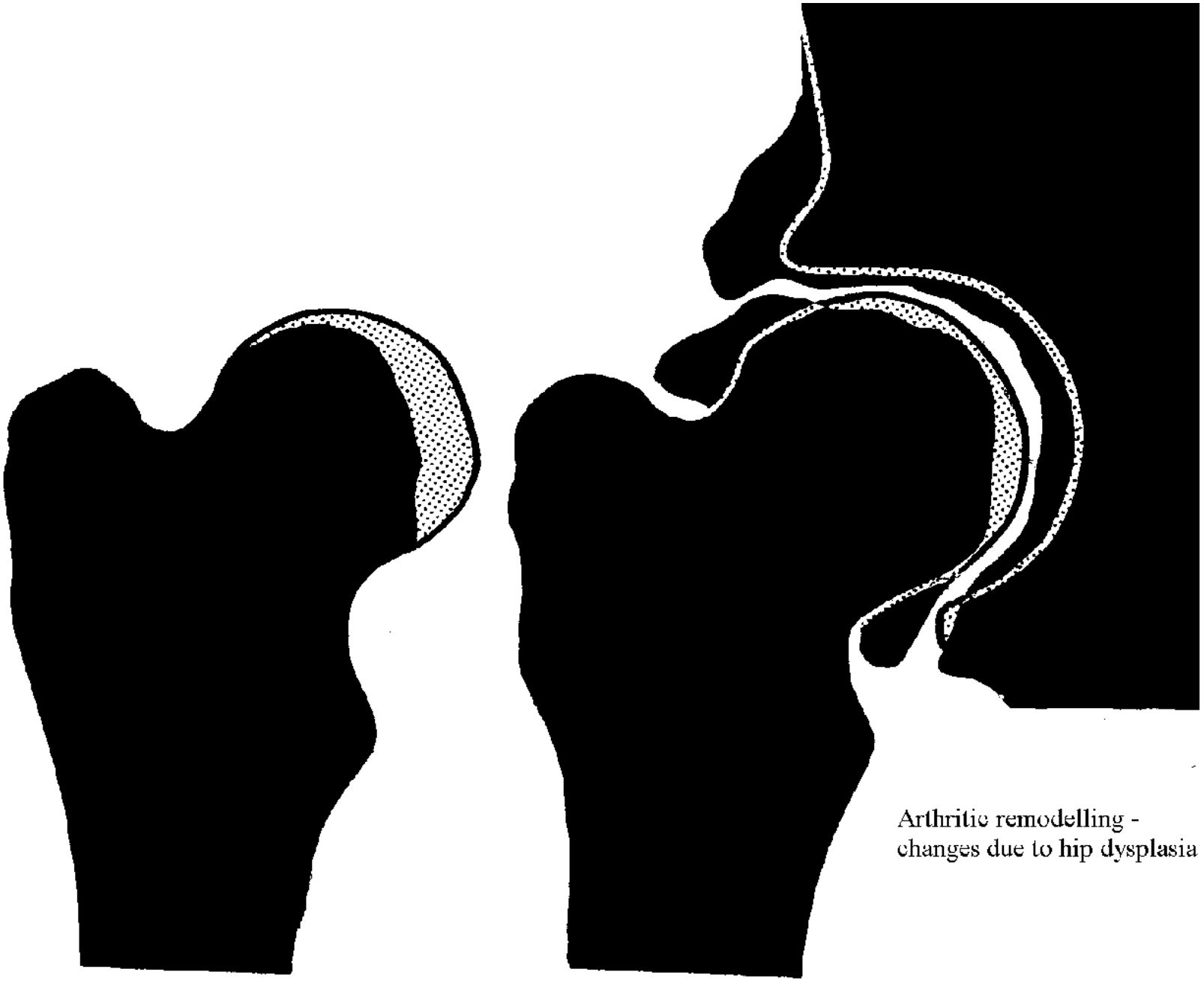
a - cranial acetabular margin
b - craniolateral rim
c - lateral acetabular margin
d - caudal acetabular margin
e - ventral acetabular margin
f - acetabular notch
g - acetabular fossa
h - femoral head
i - femoral neck
j - junction of head and neck

Anatomical Points of the hip.



Normal hip formation
- correctly positioned for X -raying
for HD assessment

Diagram - Arthritic changes over time in the hip



Arthritic remodelling -
changes due to hip dysplasia

Schemes to reduce the severity and Incidence of HD/ED

- ***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 polygenetic 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 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).
- *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/Medians

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.

- **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***

  This is where the last 3-5 years breed averages are “rolled” – allowing breeders to see recent progress and at the same time allowing room for small dips and rises with the genetic material being used.

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 can 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.

- The next step – Sires statistics or EVB's (estimated breed values)

Golden Retriever Hip Data

The grand mean (from the total of all G.Ret Xrayed is currently at **14.6** This was originally around **22** some 20-25 years ago.

. AVA average is sitting at **15.12** (from 6513 dogs Xrayed) with the NZ average sitting at **12.33** (666 dogs Xrayed)

- Calculating the average in this way can disguise any progress that has been made and may not reflect today's breed, as the estimate will be "weighted" by the scores of dogs from the past. It is therefore useful to look at information from more recent dogs separately.

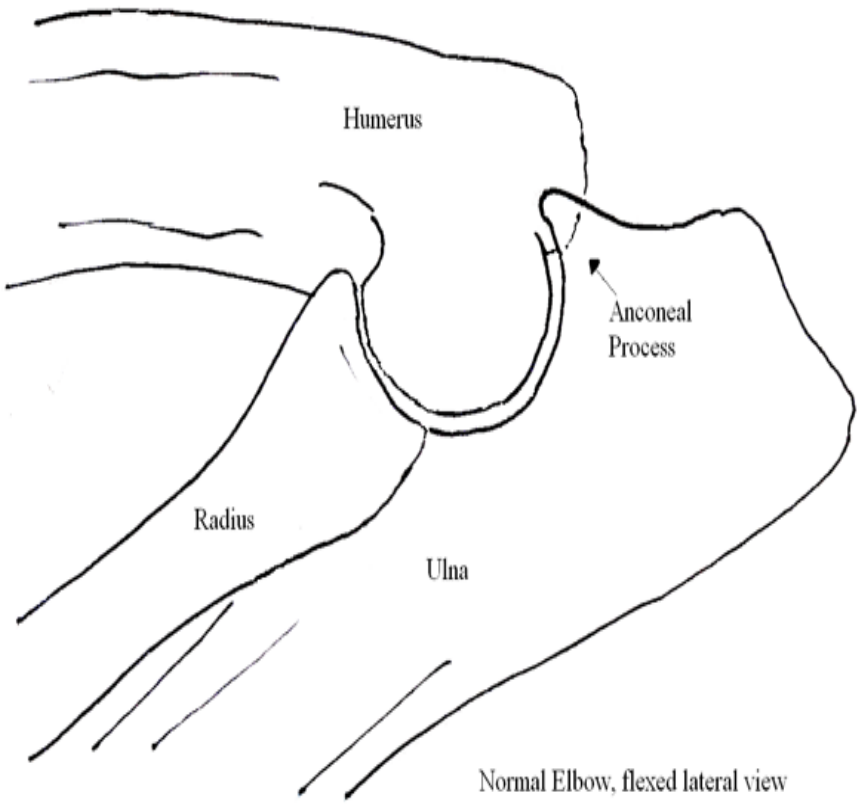
The current rolling 5 year Australian breed average (2007) is **11.5**. This shows how effective these schemes can be if used properly.

Table 2: Means and Median Total Hip Scores calculated yearly and in three-year and five-year rolling blocks

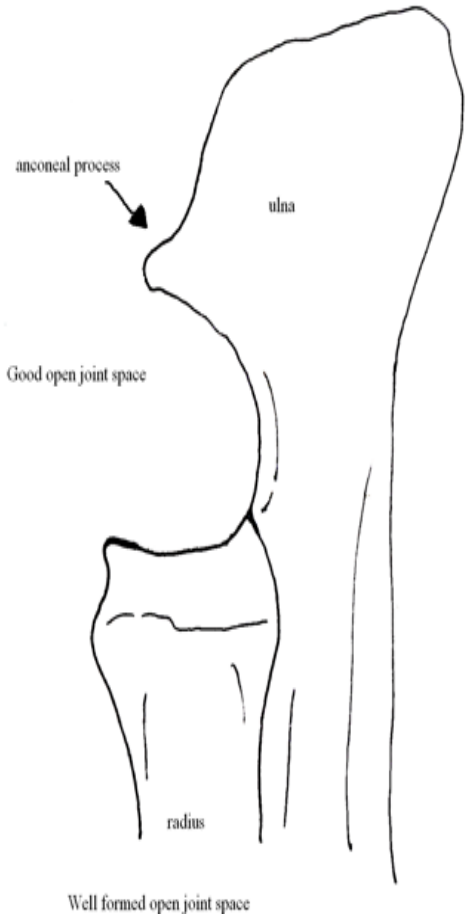
	one year		Rolling three years to		Rolling five years to	
	Mean	**Median**	**Mean**	**Median**	**Mean**	**Median**
1993	15.7	12	15.9	12	16.1	13
1994	15.6	12	15.6	12	15.9	12
1995	14.3	12	15.2	12	15.4	12
1996	14.4	12	14.8	12	15.1	12
1997	15.1	12	14.6	12	15.0	12
1998	16.2	12	15.1	12	15.1	12
1999	14.2	11	15.1	12	14.8	12
2000	13.4	10	14.5	11	14.6	11.5
2001	12.7	11	13.4	11	14.2	11
2002	12.4	10	12.8	11	13.6	11
2003	12.0	9	12.4	10	12.9	10
2004	12.0	9	12.2	10	12.5	10
2005	10.2	8	11.5	9	12.0	10
2006	11.5	9	11.3	9	11.8	9
2007	11.1	9	10.9	8	11.5	9

Elbow Dysplasia

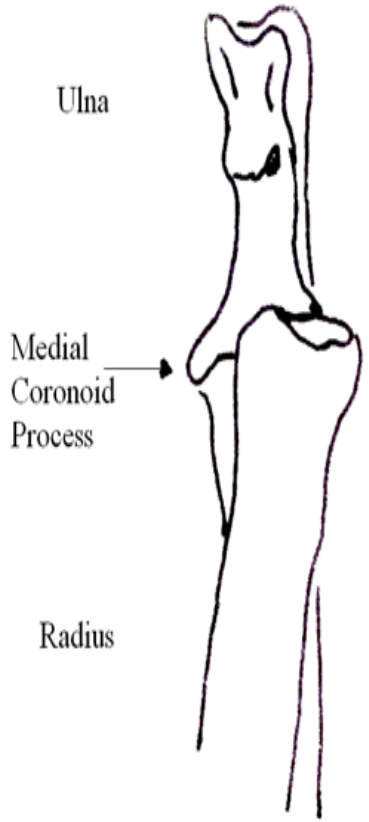
Normal Elbow



Normal Elbow, flexed lateral view



Well formed open joint space

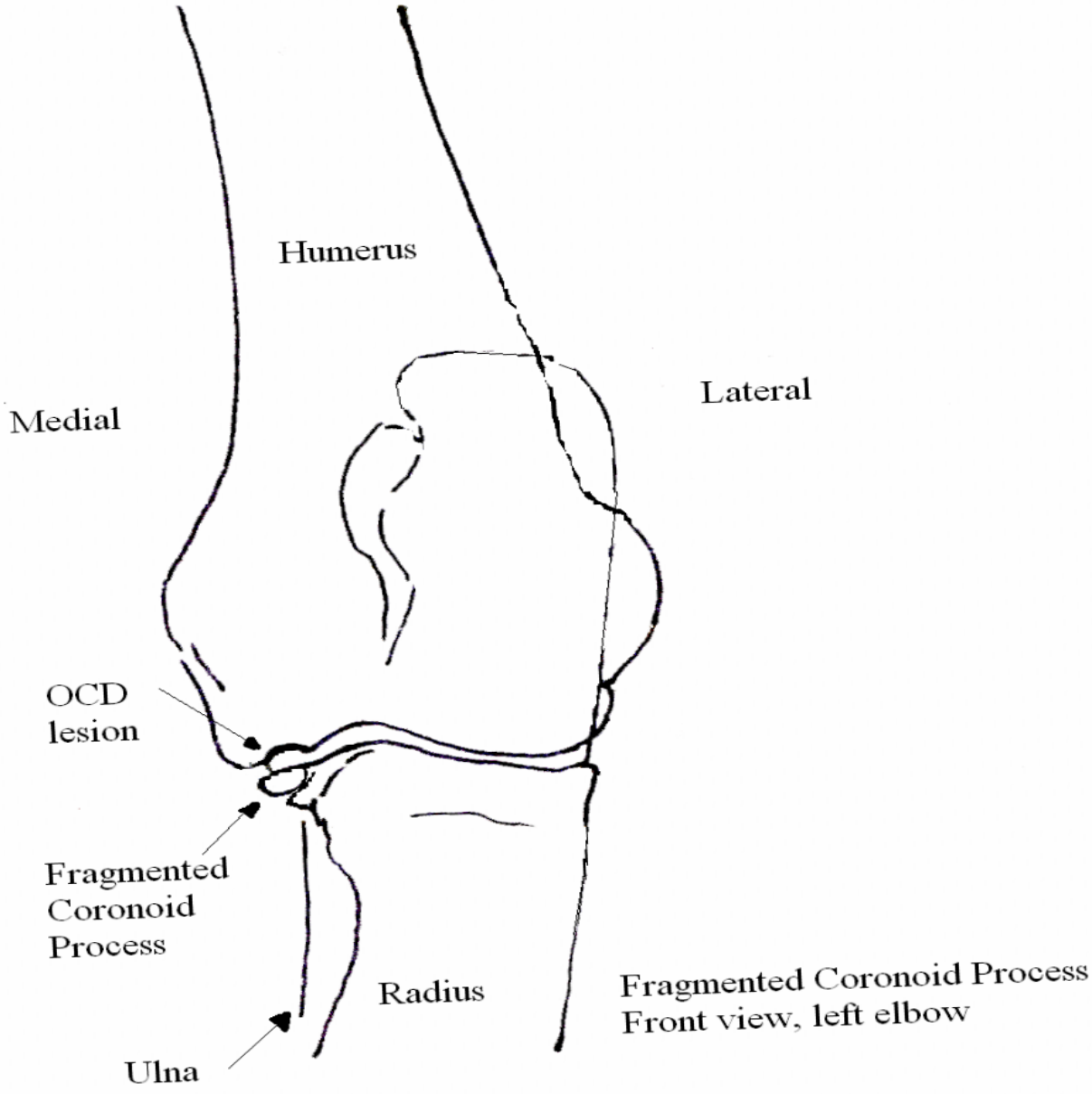


Front View Left Radius & Ulna

Elbow Dysplasia (ED)

- The elbow is quite a complicated joint, as there are 3 bones that must line up ***precisely*** in order to form a stable working joint.
- ***Any deviation from proper congruity between the various bones, either in length between the weight bearing surfaces of the radius and ulna, or a reduced ulna notch where the distal end of the humerus sits to form the top half of the joint, will result in arthritis***

OCD Fragmented Coronoid



OCD – UNEVEN GROWTH OF RADIUS

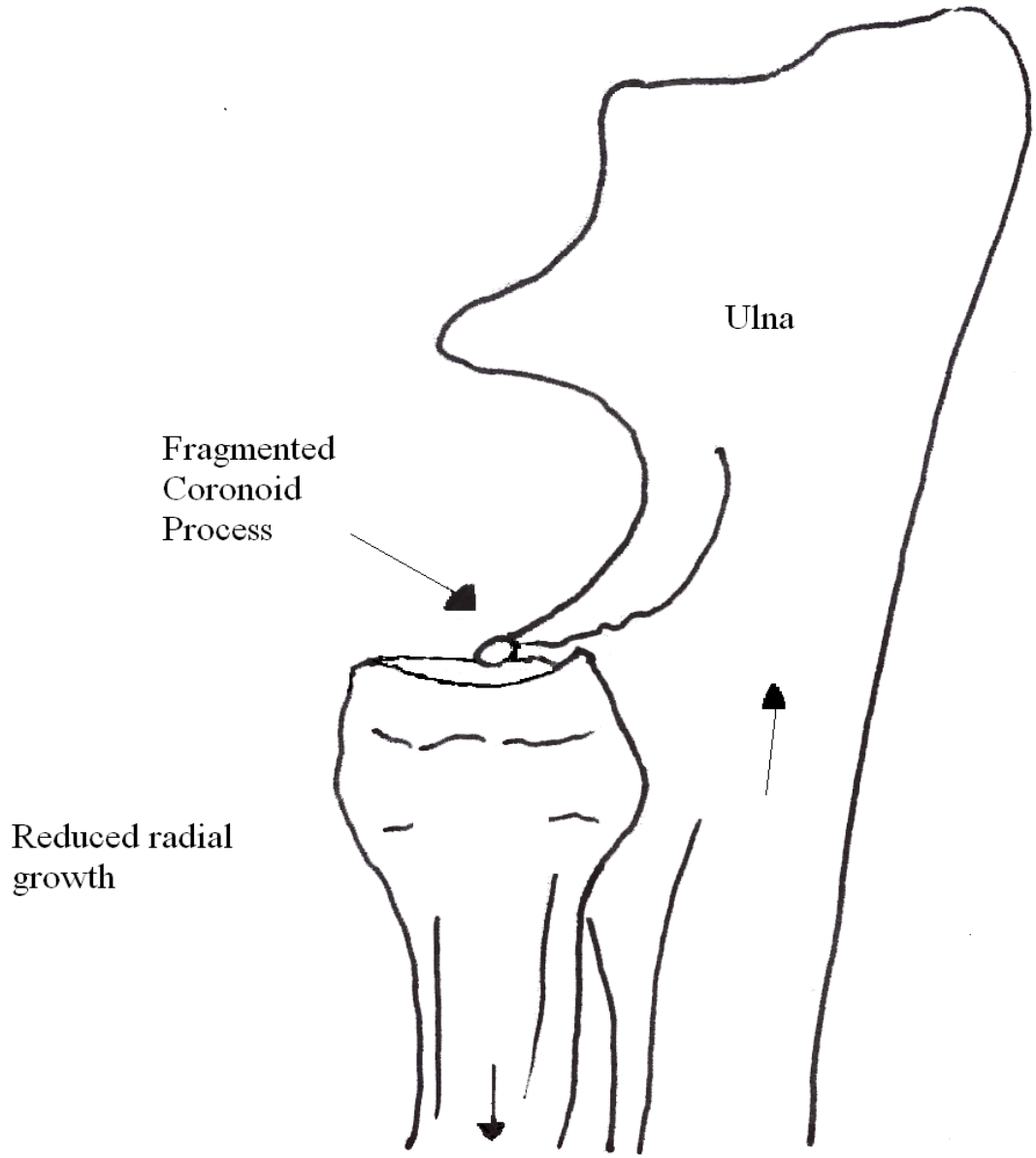
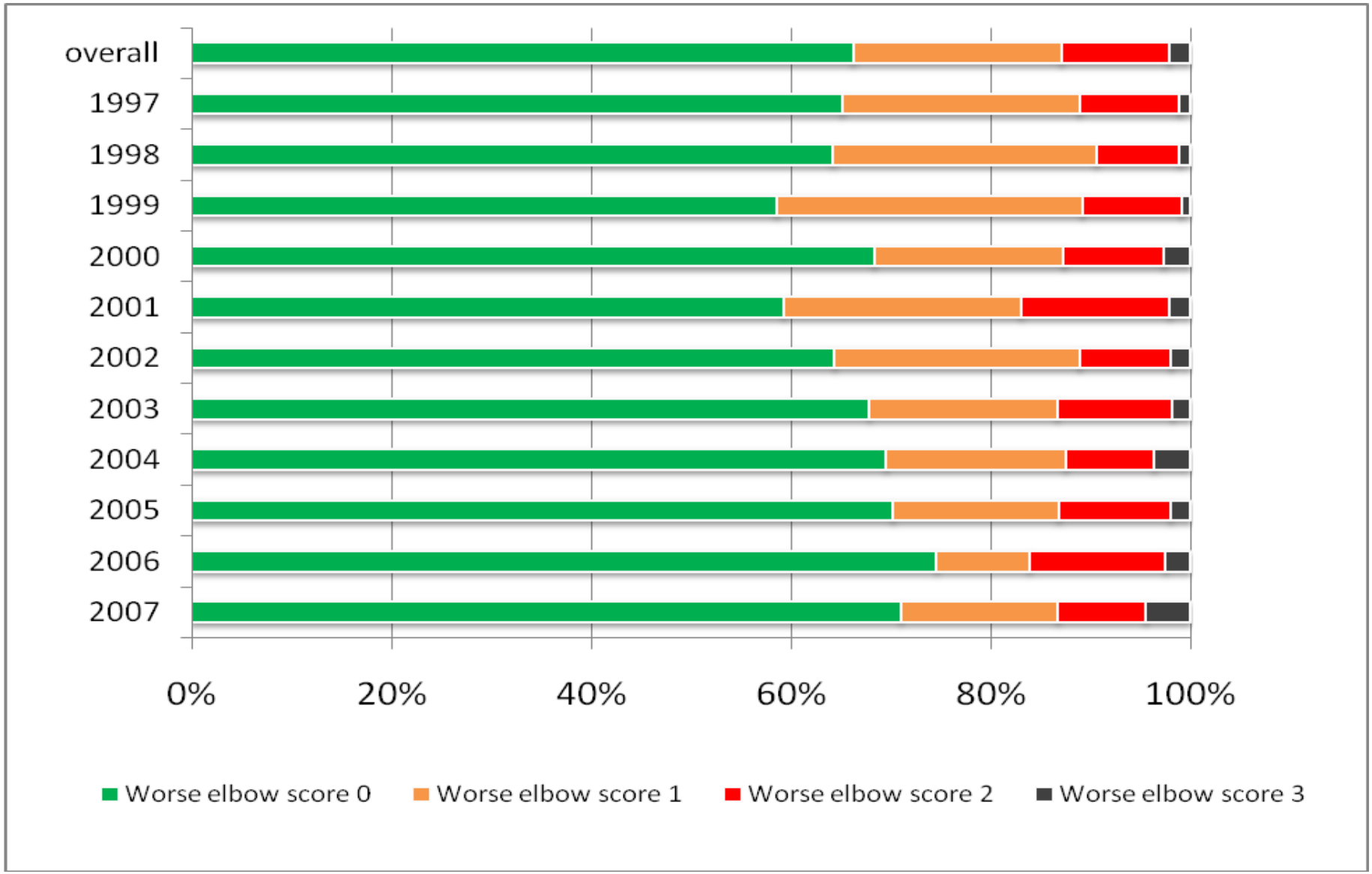


Table 3: Percentages of worse elbow scores by year of birth and overall

		Score of Worse Elbow (%)			
Year of birth	**Number**	**0**	**1**	**2**	**3**
1997	181	65.2	23.8	9.9	1.1
1998	193	64.2	26.4	8.3	1.0
1999	232	58.6	30.6	9.9	0.9
2000	269	68.4	19.0	10.0	2.6
2001	349	59.3	23.8	14.9	2.0
2002	371	64.4	24.5	9.2	1.9
2003	346	67.9	18.8	11.6	1.7
2004	250	69.6	18.0	8.8	3.6
2005	259	70.3	16.6	11.2	1.9
2006	205	74.6	9.3	13.7	2.4
2007	154	71.1	15.7	8.8	4.4
overall	2809	66.3	20.9	10.8	2.1

Chart representing percentages of worse elbow scores by year of birth and overall



Breeding with ED

- Breeding from dogs with significant arthritic changes (Grade 2) in the elbows should only be with care and ***ideally always be to normal partners and preferably to those lines with low incidences of elbow problems.*** Grade 1 animals can be bred to a wider range of animals, but, again, ideally to normal partners.

- With the elbow results, as with the hips, 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. To try and give an extra loading on results, we can loosely grade sires by the % of normal elbows being produced. Slight variations due to state averages (local population genetics) can effect these results.

Breeding with ED cont.

- Sires can further be loosely grouped on their progeny results and the % of normals. These sires can then be graded as to their effectiveness as sire for producing good elbows. I would suggest the following loose designation in assessing sires for the soundness of their elbow producing.
- **Sires that produce greater than:-**
- ***>85% normal elbows should be considered excellent producers of good elbows***
- >70% normal elbows should be considered very good producers of elbows
- >60% normal elbows should be considered good producers of elbows
- **Sires that produce less than :-**
- < 60 % normal elbows should be considered poor producers of elbows

Joint Disease and Rapid Growth

- Many of the joint diseases that occur in the **younger** dog and 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.

Rapid Growth cont.

- 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 anywhere between 15-25% heavier than females at any one time (and certainly by full maturity), despite being born at a comparable weight.
- Equally, this is not to say that genetics does not pay a very 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.

Developing a Growth Chart for your breed

What becomes very important is developing a weight for age chart similar to that we have developed for the GSD.

Too rapid a rate of weight gain will significantly increase the incidence of elbow dysplasia.

By handing out a weight for age chart for both males and females to all puppy buyers, this give breeders a very useful tool to keep track of reasonable weight and rates of weight gain

German Shepherd Growth Chart

approximate figures/ranges

Age Months	Male Range	Male average	Female Range	Female Average	% Adult weight (approx)
1	2.5-4	3.5	2- 3.5	3	10
2	6- 9	7	5- 7.5	6.5	22
3	10-14	12	8- 12	10	40
4	16-18	17	14-16	15	50
5	18-22	21	16-20	18	60
6	22-26	24	20-22	21	70
7	26-28	27	22-24	23	80
8	28-30	29	24-26	25	85
9	29-32	31	25-27	26	90
10	30-33	32	26-28	27	92
11	30-34	33	27-29	28	95
12	32-34	34	27-29	28	95
18	32-36	36	27-30	28	98
24	32-38	37	28-30	29	98
36	36-40	38	28-32	30	100

Some generalizations on GSD growth rates

- **1. Males** – between 12-20 weeks on average are gaining up to 1-1.25 kg max /week.
    - between 20-26 weeks, gaining .75-1kg max per week.
    - between 26-35 weeks gaining .5-.75kg/week
- Male GSD's *largely stop growing in height* by 9 months and may gain an extra 1cm (maximum)in height by 15 months.
- Adult Male18 months Average weight range 32-38kg Average36,
  Male full grown 3-4 years Average weight range 36-40kg Average 38kg

- **2. Females -** between 12-20 weeks are gaining up to .75-1kg maximum week,
    - between 20-26 weeks, gaining .5-.75kg maximum week,
    - between 26-32 weeks, gaining .25-.5kg/week
- Female GSD's *largely stop growing in height* by 8 months of age and may gain up to 1cm in height by 12-15 months of age.
- Adult Female 18months - average weight range 26-32kg Average 28kg
  Fully grown female 2-3 years - average weight range 26-32kg, Average 30kg

- ***#The weight of a puppy (male or female) at 4 months is roughly ½ the adult end weight.***

Golden Retriever Growth Chart - interim

Age Months	Male Range	Male average	Female Range	Female Average	% Adult weight (approx)
1	2-3.5	3.0	1.8- 2.8	2.5	10
2	5-8	6.5	4-7	6.0	22
3	**9-13**	**12**	**7- 10**	**9**	40
4	**14-18**	**16**	**12-15**	**13**	50
5	**18-21**	**20**	**15-18**	**16**	60
6	**20-24**	**23**	**18-20**	**19**	70
7	24-26	25	20-22	21	80
8	25-28	27	22-24	23	85
9	27-30	29	23-26	25	90
10	28-31	30	24-27	26	92
11	29-32	31	25-28	27	95
12	30-33	32	26-29	28	95
18	32-36	34	27-29	28	98
24	32-38	35	28-30	29	98
36	32-38	36	28-32	30	100

Golden Retriever Growth Rates

some starting suggestions -

- **1. Males** – between 12-20 weeks on average are gaining up to .8-1.0 kg max /week.
  - between 20-26 weeks, gaining .5 - .75kg max per week.
  - between 26-35 weeks gaining ..25- .5 kg/week

- Male Golden Retriever's *largely stop growing in height* by 9 months and may gain an extra 1cm (maximum) in height by 15 months.
- Adult Male18 months Average weight range 30-36kg Average 32-34,
- Male full grown 3-4 years Average weight range 34-36 kg Average 35kg

- **2. Females -** between 12-20 weeks are gaining up to .5- .75kg maximum week,
  - between 20-26 weeks, gaining ..25 -.5 kg maximum week,
  - between 26-32 weeks, gaining around.25kg/week

- Female Golden Retrievers's *largely stop growing in height* by 8 months of age and may gain up to .5-1cm in height by 12-15 months of age.
- Adult Female 18months - average weight range 22-30kg Average 24-26kg
- Fully grown female 2-3 years - average weight range 24-28kg, Average 26kg

#The weight of a puppy (male or female) at 4 months (16 weeks) is roughly ½ the adult end weight.

Royal Canin Golden Retriever Data

Adult Male weight range 31.7 — 36.3 kg

(rounded to 32-37kg, average 35kg)

Adult Female weight range 27.2– 31.7kg

(rounded 27-32 kg, average 28kg)

Maximum weight gain per month

3-4 months	1 kg/week males,	.8kg/week females
4-5 months	.85kg/week males,	.7kg/week females
5-6 months	.7kg/week males,	.6kg/week females
6-7months	.6kg/week males,	.5kg/week females
7-8months	.5kg/week males,	.4kg/week females

New Owners and Pet Owners

- Many pet owners pick up their puppies (usually at a good weight), go home and then start fiddling with diets. Veterinarians may then add their preferences for types of dry food and different diets.
- Puppies often become picky eaters mostly due to lack of competition having come from a litter, and diets get changed even further.
- The ***type of dry*** food can make significant differences in weight gains, particularly the super premium or more concentrated dry foods.
- The high energy or calorie diets are easily overfed as being concentrated, the correct amount to be fed can look very “small”, so inexperienced owners often increase the amounts per feed.

New Owners cont.

- I would also suggest that feeding high energy foods to pets with sedentary life styles is probably *not* an ideal thing as it tends to make the dogs more hyperactive.
- To avoid this, with my own GSD puppies, I suggest that the puppies go onto a middle of the road, average quality adult dry food from 8-12 weeks onwards. Usually I suggest a complete dry food with 22-24% protein and 12-14% fat. Further I usually suggest that one feeds ¾ dry food to ¼ what ever (chicken, red meat, cheese etc). If these dry foods are overfed the consequences are not as drastic in relation to rate of weight gain or activity wise.
- Looking at the interim chart, one can see there are tremendous growth spurts occurring between the 2-5 month period. Excessive rates of gain on a per week basis can set up joint problems for life.
- While we as breeders and exhibitors tend to keep a close eye on the weight of our puppies (show puppies in particular), novices and pet owners are not nearly as attentive in this area. Most pet owners prefer their pets “well covered”!