

Feeding Large Breed Puppies

Jennifer A. Larsen DVM, PhD,
Diplomate, American College of Veterinary Nutrition
Associate Professor of Clinical Nutrition
Nutrition Support Service
William R. Pritchard Veterinary Medical Teaching Hospital
University of California, Davis

Key Points:

- Adult foods are often inadequate for large breed puppies.
- Choose a diet formulated for large breed growth instead.
- Avoid supplementation with vitamin and mineral products.
- Keep growing puppies lean to reduce the risk of abnormal skeletal development.

Puppies have specific dietary requirements that differ from those of adult dogs. Owners are often given advice from various sources regarding feeding their puppy; however, the soundness of these recommendations is variable and some are unsafe. In particular, the use of diets not formulated for growth, many home-prepared diets, and feeding too much of any diet, are all risk factors that can be avoided. Improper feeding management or the use of inappropriate diets can lead to the development of rickets and other developmental nutritional diseases that can have significant detrimental effects. Deficiencies in phosphorus, calcium, and vitamin D are well defined as contributing to conditions such as rickets; however, other disruptions of orthopedic development secondary to dietary causes may be less dramatic but more common. Large breed puppies are predisposed to these problems due to their genetic potential for rapid growth. Additionally, excessive body weight can cause stress on the immature developing skeleton. If energy intake is not controlled, or if the mineral balance of the diet is not within safe ranges, developmental orthopedic disease (DOD) can result. Although genetics, exercise, trauma, and other factors can impact the skeletal development of puppies, the diet is one factor that every owner can and should control.

Nutritional factors

A significant volume of research has been published to describe the connection between improper nutrition and a variety of skeletal abnormalities (including hypertrophic osteodystrophy, osteochondrosis dissecans, and cervical spondylomyelopathy or 'wobbler' syndrome) in large breed puppies. One of the first studies used experimental diets that varied in many respects, including protein concentration, energy density and mineral concentrations, and it was unclear which factor(s) contributed to the abnormalities observed.¹ It was later demonstrated that dietary protein concentration had no effect on skeletal development.² While there is no scientific support for adverse effects of protein intake, other dietary factors, especially excessive calories and inappropriate amounts of calcium, have been shown to negatively influence optimal skeletal development in large breed puppies.

Energy

Research has demonstrated that rapid growth results from ad libitum feeding of energy dense diets and that excessive body weight has an adverse effect on skeletal development, including increased risk of DOD.^{1,3} This is because fast bone growth results in structural defects of bones that are in turn unable to accommodate an increased body weight, and large breed puppies have decreased bone density compared to smaller breed puppies³.

Any food has the potential to cause problems with skeletal development if overfed; however, maximal growth in puppies commonly occurs with feeding a highly palatable, highly energy dense, growth diet. Overeating can occur if puppies are fed on a free choice basis, or if too much is fed on a meal basis, regardless of energy density. A body condition score (BCS) system is a tool that can easily be adopted and used by owners.⁴

Energy requirements for puppies are approximately three times the resting energy requirement (RER; $70 \times \text{body weight in kg}^{3/4}$) until four months of age, then two times RER for the remainder of the growing period.⁵ While this and similar equations can be used to estimate the calorie needs for puppies, these are not expected to be entirely accurate for an individual puppy. Breed and individual differences as well as

environmental factors such as climate and activity level will all affect the amount of food required. Since growth rates and energy needs can vary between individual dogs, even siblings, so adjustment of the diet should be individualized based on regular assessment of the BCS. The goal is to keep growing puppies at a BCS of 4 on a 9 point scale, which has been shown to promote a longer lifespan and better quality of life if maintained long-term.⁶

Calcium and other nutrients

In addition to excessive energy intake, inappropriate amounts of calcium have also been shown to increase the risk of DOD.⁷ Some breeders and dog fanciers advocate calcium supplementation for growing pups; however, excess calcium is potentially very detrimental to the development of a healthy skeleton. Calcium supplements should not be recommended for healthy puppies eating commercially available complete and balanced diets. Unlike adult dogs, puppies appear to have inefficient mechanisms for regulating how much dietary calcium is absorbed from the intestinal tract, which can result in excessive absorption and retention of calcium, especially when the dietary calcium concentration is high.⁸⁻⁹ Excessive calcium can result in skeletal malformation¹⁰, and can cause deficiencies in other nutrients, especially zinc.¹¹

Feeding a diet with too little calcium is equally problematic, and the resulting disease (nutritional secondary hyperparathyroidism) develops much more quickly and with more serious consequences in puppies compared to adult dogs. In this case, parathyroid hormone concentrations are increased, which subsequently increases calcium release from the skeleton and can result in soft, malformed bones and fractures. Many home-prepared diets do not provide appropriate concentrations of calcium and other essential nutrients.¹²⁻¹³ Many vitamins and minerals, including phosphorus, vitamin D, vitamin A, copper, zinc, and manganese are also important for proper skeletal formation. Dietary phosphorus concentrations in particular must be considered in relation to calcium concentrations. The ratio of calcium to phosphorus should be approximately 1:1 to 1.5; however, absolute amounts of each nutrient are more important than the ratio.⁸

Published studies that have reported the optimal dietary calcium concentrations for growing puppies have typically compared dogs of extreme sizes (miniature poodles and

great Danes); however, it is generally accepted that the findings also apply to other breeds and sizes of dogs. In general, three ranges of calcium intakes have been investigated (low [0.3-0.5% dry matter (DM)], average [1.1-1.2% DM]), and high [$>3\%$ DM], and there are few data available that report the results of feeding intermediate concentrations of dietary calcium. One study showed poor growth rates in puppies of various breeds and sizes that were fed diets providing 0.9% DM or less and 2.3% DM or greater calcium¹⁴. Both large and small breeds appear to grow safely consuming diets providing 1.0 to 1.5% DM calcium (or approximately 3 grams calcium per 1000 kcal). For canine growth diets, the Association of American Feed Control Officials (AAFCO) has established a minimum of 1% DM calcium (with a current maximum of 2.5% DM for both growth and maintenance; proposals to lower this maximum are being discussed)¹⁵, while the National Research Council (NRC) provides a recommended allowance for growing puppies of 1.2% DM calcium (with a safe upper limit of 1.8% DM for growth), with no distinction for breed size or growth rate.¹⁶

In fact, there are currently no regulatory guidelines for puppy size. Some diets marketed as being “low carb” or “grain free” are high in mineral content and may not be appropriate for growth, especially for larger, more rapidly growing puppies if the calcium concentration well exceeds the NRC safe upper limit. The AAFCO maximum is higher than the NRC safe upper limit, but the exact concentration at which risk of DOD is significant for any given puppy is not known. However, we do have clear evidence that calcium over 3% DM can result in significant bone abnormalities and intakes of 2.3% DM can result in poor growth in breeds of various sizes¹⁴, but we have little data on calcium intake in the intermediate range of 1.5 to 2.3% DM. The NRC explicitly states that the true safe upper limit is “very likely” higher in slower growing big pups and in small pups, so the current value is considered a conservative limit for rapidly growing, large breed dogs.

Diet selection

Many breeders and some veterinarians will advise owners of large breed puppies to feed commercially available adult dog foods. The goal of this practice is presumably to provide a less energy dense food with less dietary calcium and to prevent excessive

growth rates. However, this advice is much too vague to be consistently and safely interpreted. The broad category of adult canine maintenance foods encompasses hundreds of diets with an extremely wide range of nutrient profiles, caloric densities, and mineral contents. In fact, some foods marketed for adult maintenance have been formulated for and/or tested to prove adequacy for growth, while others have not. In many instances, maintenance diets provide more calcium per calorie and/or have more calories per cup than growth diets designed for large breed puppies. As such, the advice to use “adult” foods is not useful both for practical and scientific reasons. Growth is a life stage with specific nutritional demands. Diets should be formulated for specific life stages, and preferably will have passed AAFCO feeding tests to prove adequacy.

In most cases, growth diets for puppies of all sizes as well as those for large breeds provide calcium concentrations in the safe range; however, those specifically for large breeds are less energy dense and therefore are less likely to be overfed. The growth diet should be fed until growth plate closure has occurred, which likely varies among individuals, since this timing is influenced by the rate of growth and the presence of joint dysplasia, and is impacted by hormones (and therefore neuter status).¹⁷⁻¹⁸ It is not detrimental to keep a healthy, lean puppy on growth formula until or beyond the point at which full adult size is achieved. When such a diet is fed, vitamin and mineral supplements are unnecessary and potentially harmful.

Home-prepared diets

If the use of a home-prepared diet is desired, this must be done carefully to avoid problems that may result in life-long disability. Further, although many recipes for home-prepared pet foods are available on the Internet and in books, the vast majority of these are not balanced. Nutritional adequacy is a big concern. There are several studies that have evaluated home-prepared diets for nutritional adequacy with laboratory analysis or computerized assessment. One study that evaluated 200 recipes for home-prepared diets intended for canine maintenance were assessed by computer, with a subset undergoing laboratory analysis, and very few of these met or exceeded the AAFCO or NRC recommended minimal concentrations for all essential nutrients.¹² Since growth is

a demanding life stage, these concerns are magnified for puppies. Typical problems with most recipes include:

- vague ingredient specifications or preparation instructions,
- assumption of equivalent unlimited substitutions of ingredients,
- inadequate instructions for supplementation,
- and outdated strategies for addressing specific disease conditions.

Additionally, many such recipes do not provide any instructions with regard to energy content and the amount to feed an individual pet. Such recommendations are in essence putting the onus of appropriate preparation and supplementation on the owner or on the veterinarian, which is inappropriate.

Although a preliminary evaluation can be done (i.e. does the recipe include a calcium source?), the diet recipe must also undergo quantitative assessment of nutritional adequacy. The provision of all essential nutrients, plus any necessary safety factors or adjustments based on individual animal factors (including a lower than expected energy requirement) must be considered. This is a quantitative, computer-driven process, and consultation with a qualified veterinary nutritionist (a Diplomate of the American College of Veterinary Nutrition (ACVN)) is recommended.

Conclusion

During growth, it is most important to meet essential nutrient requirements and to maintain an ideal (lean) body condition. This is most easily accomplished with the use of a commercially available diet formulated for growth and specifically for large breed puppies.

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