The Role of Biometrics in Canine Oral Health and Nutrition

By Dr. Tiffany L. Bierer

Biometrics refers to the science concerned with the accurate measurement of the characteristics of living things—"biometry"—such as dimensions and weights. Biometric techniques are used to study how individuals differ from one another. Examples of this are the discovery of fingerprints, retinal scans and skull shapes and how these differ from individual to individual. These discoveries have led to the development of fingerprinting techniques and eye scanning equipment that can ascertain an individual's true identity. Biometrics has been a valuable tool to forensic scientists who can now build an accurate replica of a person's facial features starting with a skull. This work has led to the identification of many missing persons. Biometrics can also be used within a species or population to help us understand the variation within that group.

Biometrics and animal chewing behaviors

Among all animal species, canines have the largest degree of size variation. But they don't just vary in size; they vary in shape as well. Gaining a better understanding of how these different sizes and shapes affect how a dog functions helps us to better care for every type and size of dog.

Previous work examining several different animal species have suggested that differences in skull shape and size can have a profound affect on that animal's chewing capabilities and characteristics. Skull shape and size determines where the teeth are positioned within the mouth, where the muscles lay surrounding the jaw, how far the mouth can open and close and how much pressure can be applied through biting. These differences can ultimately influence the foods an animal chooses to eat and how they eat it. (Jaslow, 1987; Van Valkenburgh, 1989)

Because of the wide variation in the size and shape of skulls within the canine population, understanding the oral biometrics of the dog becomes very important. Given the variations among dog sizes and shapes, we can expect a related amount of variation in canine skull shapes and sizes. This is especially important to understand when caring for the

and nutritional products.

Canine skull shapes

Dogs may be classified as having one of three types of skulls: Brachycephalic, Mesaticephalic or Dolichocephalic. Brachycephalic types have a broad-based skull and a short muzzle (Figure 1). These dogs are commonly described as "flat faced" and include such popular breeds as the Boxer, Mastiff, Pekingese and the Bulldog breeds. Because of their short muzzle, these breeds tend to have less space in their mouths for their teeth. They tend to have a higher degree of missing teeth or have oddly aligned teeth that can cause chewing difficulties (Figure 2).

Mesaticephalic types have a medium skull width and medium muzzle length (Figure 3). Dog breeds that exhibit a characteristic mesaticephalic skull type include Labrador Retrievers, Golden Retrievers, Cocker Spaniels and the Maltese. The last skull type is Dolichocephalic (Figure 4). This class of skull includes breeds such as the Rough and Smooth Coated Collie, Greyhounds, Whippets and Dachshunds. The characteristics of their skulls include a narrow skull base with a long, narrow muzzle.

Figure 1

Figure 2

Figure 3

Figure 4

Measuring chewing capabilities

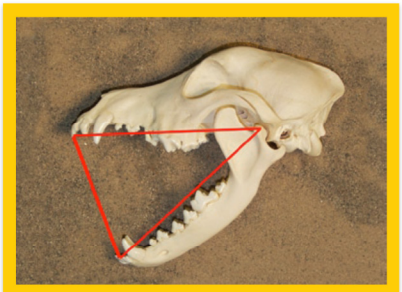

Figure 5

Many scientists investigate an animal's chewing capabilities through the use of predictive equations based on skull dimensions (Figure 5). These equations can be used to calculate various chewing capabilities including maximum bite force, or how much pressure an animal is capable of producing when biting down. These maximum bite forces can be calculated not only as an average for the entire mouth but also at each tooth position. These types of equations are utilized in the study of many different animal species, helping biologists to understand a species' selection of particular foods based on the morphology of that species' skull and resulting chewing capabilities.
(Williams, et. al., 2005)

Bite force capabilities in canines

Recently, attention has been given to the maximum bite force capabilities of dogs. A study by Thomason from the University of Guelph (submitted for publication) used predictive bite force equations on 130 dog skulls obtained from various museum collections, ranging from the small and toy breeds to the giant-sized breeds. The skulls measured not only represented different sizes of dogs but also different skull types within those sizes.

The conclusions of this study include: *The maximum bite force capability of a dog increases as the size of the dog increases.* This is an intuitive conclusion that is now supported by the data in this study.

The maximum bite force capability of a dog increases from the front of the mouth to the back of the mouth. This means that harder food sources would be chewed toward the back of the mouth where higher pressures can be exerted during chewing while softer foods are capable of being chewed by a greater range of teeth. It helps to explain the chewing behaviors observed in dogs consuming products with different hardnesses.

The maximum bite force capability of a dog can be affected by the skull type. Within some dog sizes, the effect of skull type is minimal—all dogs in that size range demonstrate similar bite force capabilities. However, in other size ranges, skull type exerts a greater influence. For example, in large dogs over 50 pounds the bite force capacity of dogs with a Brachycephalic skull type are much greater than dogs of the same weight with a Dolichocephalic skull type.

Treat them good.

Relevance of canine bite force data

Understanding the chewing capabilities of dogs helps us to better understand their feeding behaviors and how to better provide for them.

Biometric data can be utilized to formulate and develop products based on factors such as the bite force capacity of dogs. A better understanding of the chewing capabilities of dogs allows for “smart” product design (Figure 6).

For example, many brands offer a range of product sizes aimed at different dog size ranges, i.e., large sizes for large dogs, small sizes for small dogs.

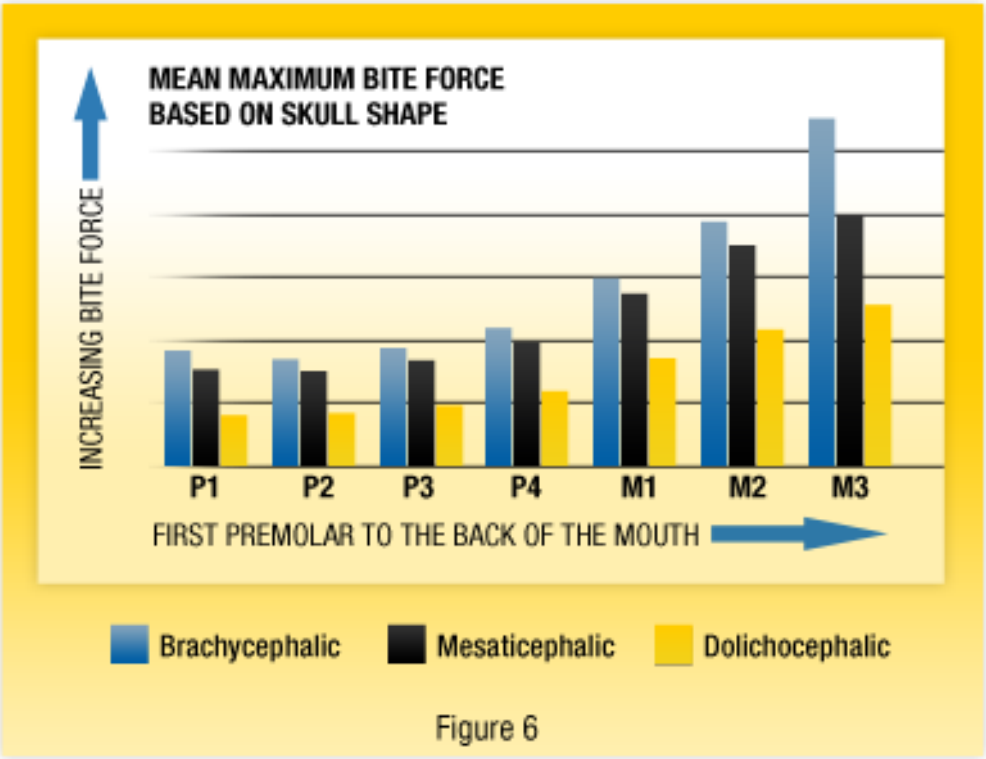

Figure 6

These products commonly differ only in their relative size. Product shape, dimension ratios, textures and formulations generally remain the same between sizes. One key disadvantage in the design of these products is that it can fail to account for fundamental anatomical differences in dogs. One very distinct anatomical difference among dogs of different body weights and shapes is in their biting and chewing capability. Understanding the anatomical and functional differences of a group of dogs makes it possible to design oral healthcare products that better match their respective needs. The result can be a series of products that differ not only in size relative to the dog sizes, but now also differ in texture, shape and formulation to better accommodate specific groups of dogs.

Conclusions

Among all animal species, canines exhibit the greatest variations in size. In addition to size variation, canines also exhibit a variety of skull types. Studies of other animal species have shown that skull type and size can greatly influence chewing behaviors, capabilities and ultimately, food preferences. Better understanding of the different chewing capabilities of different sizes and skull shapes of dogs can lead to products specifically developed for these animals. This knowledge can contribute not only to product development, but also lead to safer, more efficacious oral health and nutritional products for all types of dogs.

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Figure 2 provided by Jan Bellows, DVM, Dipl. AVDC, ABVP

Figure 5 provided by The University of Guelph, Ontario, Canada

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