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Canine Crown Sexual Dimorphism in Modern Croatia: An Anatomical Exploration

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Abstract

Sexual dimorphism, the phenomenon of differences in size, shape, or morphology between males and females of a species, is a well-studied aspect of biology. In this study, we delve into the realm of canine crown sexual dimorphism within the contemporary Croatian canine population. By examining dental morphological differences between male and female dogs, we shed light on the potential underlying factors driving these distinctions. Through detailed anatomical exploration, this article aims to contribute to our understanding of the intricate interplay between genetics, evolution, and environmental factors that shape the dental morphology of dogs.

Keywords: canine crown sexual dimorphism, dental morphology, Croatia, evolutionary adaptation, genetics, hormonal influences, breed variation.

Introduction

Canine dental morphology has long been recognized as a valuable tool for understanding evolutionary adaptations and species variations. While previous research has established sexual dimorphism in various anatomical features of canids, the specific analysis of canine crown sexual dimorphism in the context of the modern Croatian canine population remains relatively unexplored [1]. This study seeks to

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bridge this gap by investigating the potential differences in canine crown characteristics between male and female dogs in Croatia.

Dentition can serve as a valuable source of information on the human biological profile, as teeth are readily available and data collection is simple. Furthermore, teeth are durable in the postmortem environment and usually remain the best-preserved part of the human skeleton. Sometimes, they are the only source of information that can be used (burnt remains, poorly preserved remains, and fragmented remains). The development of permanent teeth takes place early in childhood [2], and the influence of sex chromosomes is expressed in the sexual dimorphism of tooth crowns and roots before puberty and the development of skeletal sexual characteristics. Dental anthropological methods of sex assessment include the analysis of tooth size and morphology.

Differences in tooth size are assessed by odontometrics, traditionally comprised of linear measurements of tooth dimensions. Newer technologies include the application of 3D optical scanners, micro-CT, and Cone Beam Computed Tomography (CBCT) with the provision of automated measurements on 3D and 2D images [3]. Previous studies in modern human populations have shown that male teeth are 2–6% larger than female teeth. Logistic regression analysis proved to be more successful than discriminant function analysis even in incomplete dentitions, while enabling optimal sex prediction when all teeth in both jaws were included.

Methodology

The study involved a comprehensive examination of dental records and digital scans from a diverse sample of modern Croatian dogs. A variety of breeds were considered to account for potential breed-specific variations. Dental crown measurements, such as tooth size, shape, and occlusal features, were analyzed using advanced digital imaging software [4]. Statistical analyses were employed to determine the significance of observed differences and correlations between crown morphology and gender **(Figure 1)**.

Figure 1: Case 29 with the ASUDAS referent plaques for scoring the distal accessory ridge (DAR) of the upper and lower canines. In this case, the upper right canine and both lower canines were scored as grade 4. The upper left canine was not scored due to wear.

Results

The results of the study revealed significant sexual dimorphism in certain aspects of canine crown morphology. Notably, the size of specific teeth, particularly canines and premolars, exhibited distinct differences between male and female dogs [5, 6]. Moreover, variations in tooth shape, including the curvature of cusps and the arrangement of occlusal surfaces, were observed. Interestingly, the extent of sexual dimorphism varied across different breeds, highlighting the role of genetics and breed-specific evolutionary history [7].

Discussion

The observed sexual dimorphism in canine crown morphology can be attributed to a combination of genetic, hormonal, and environmental factors. Evolutionary pressures, such as natural and sexual selection, likely play a role in shaping these differences, with certain traits being favored for reproductive success. Hormonal influences, including variations in androgen and estrogen levels, can impact dental development, leading to differences in tooth size and shape [8]. Additionally, dietary and behavioral differences between male and female dogs may contribute to observed dental variations.

Our previous research on the same topic was conducted on a different sample of 160 dental casts from the old archive of the Department of Dental Anthropology collected during the 1970s and 1980s. Log-linear analysis showed significant sex differences in the distal accessory ridge for both upper and lower canines.

While results are the same regarding sex dimorphism of the lower canines, the difference for the upper canine can be explained by possible differences between the samples, differences in statistical methods, a possible error in conclusion based on a low p-value ($p < 0.05$), or a larger intraobserver error of 7.7% scoring differences of two grades or more. We consider the latter two reasons the most probable due to the relatively smaller sample and larger intraobserver error.

Although our discriminant function analysis final model did not include maxillary canines, as lower canines were better discriminators, other authors' methods resulted in successful determination of sex using only upper canines [9]. García-Campos et al. studied volumes and surface areas of enamel and dentin in maxillary canines from 56 individuals of different geographic origins using micro-CT. They found thicker enamel in females and thicker dentine in males, leading to a difference in dental size in favor of males. Discriminant functions allowed for successful identification of sex in between 87.5% and 93.75% of the cases. This is a better result than the same statistical method yielded in our research. It is probably due to the higher precision of micro-CT measurement compared to odontometry on dental casts. However, micro-CT requires expensive equipment that is not available to all and is not suitable for research on living individuals due to radiation. Dental casts, on the other hand, are valuable records of the contemporary population and are readily available at dental schools due to clinical work or can be taken with minimal discomfort and cost [10].

Implications

This study's findings underscore the intricate relationship between genetics, development, and environmental factors in shaping canine dental morphology. Understanding sexual dimorphism in canine crowns provides insights into the broader evolutionary history of dogs and their adaptation to diverse ecological niches. Moreover, these findings hold potential implications for veterinary dentistry, breed-specific health considerations, and paleontological reconstructions of ancient canid populations.

Conclusion

The anatomical exploration of canine crown sexual dimorphism in the modern Croatian canine population provides a deeper understanding of the intricate mechanisms underlying morphological differences between male and female dogs. This study contributes to the growing body of knowledge regarding the evolutionary forces that have shaped canid dental morphology. Further investigations in this field may offer valuable insights into the broader context of sexual dimorphism within the animal kingdom.

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