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Linkage of the Locus for Canine Dewclaw to the Chromosome 16

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The canine dewclaw is a morphological anomaly of extra toes on the hind limb, which is frequently observed in various types of dog breeds. In contrast, the canids including wolves have only four toes on their hind legs. However, in the Pyrenean mountain dog, Bauceron, and Norwegian Lundehund the double dewclaws on each hind leg are already fixed in their breeds and regarded as their unique characteristics. Although it was suggested that an extra toe might have a selective advantage as in the case of Norwegian Lundehund, the origin of this unusual phenotype is unknown. Since the closely related species of canid, e.g. the feline cluster, exhibit the same loss of first toe in their hind limb, an evolutionary reduction of limb is not an exclusive event in the canine species. From the evolutionary point of view, the dewclaw is regarded as an example of atavism. The canine dewclaw shows a similarity to preaxial polydactyly that is defined as the presence of one or more extra digits on the medial side of the extremity. However, their phenotypes are not exactly the same as the ones reported in mouse or human because of its atavistic nature. Genetic studies conducted in several breeds strongly indicated their inheritance in family, although the modes are variable. An autosomal dominant mode of inheritance was indicated for the Great Pyrenees and perhaps for other breeds including Braques and Dalmatian. On the other hand, autosomal recessive modes were reported for Border Collies and Saint Bernard. The polydactyly in St. Bernards is associated with palate agenesis, anotia, an incomplete bifid tongue, and an extra thoracic vertebra and rib. In Australian Shepherd, an affected gene was reported to be X-linked lethal or sex-influenced autosomal. It is known that large dogs frequently have extra rudimentary toes, a high rate of locomotory diseases, and high mortality rates. Locomotory diseases (elbow and hip joint problems), as well as tumors and heart disease, are common causes of increasing death rate in St. Bernards and Bernese mountain dogs. The Norwegian Lundehunds with dewclaws have extremely high rates of gastritis and intestinal lymphangiectasia. For an analysis of canine genome, both meiotic linkage and radiation hybrid (RH) maps are currently available with sufficient markers that permit linkage mapping of interested traits. Furthermore, syntenic relationship of the canine genome with the human/mouse ones is becoming more specific so that candidate genes can be easily predicted, although the current information is mostly based on data by chromosome-wide FISH. For genetically related canine pedigrees with seventy-three members of dewclaws, we carried out a genome-wide scan for linkage with microsatellites. With an assumption of autosomal dominant mode of inheritance, significant linkages were detected for the markers on the canine chromosome 16. The maximum two-point LOD score of 20.76 was obtained for the REN85M08/REN85N14 markers at a recombination fraction of 0.00. For efficient analysis of linkage, a revised order of the chromosomal markers was established by assigning all the existing markers from the previous linkage and radiation-hybrid maps. A chromosome-wide haplotype analysis revealed the location of dewclaw locus within a few centimorgan intervals delimited by the UCMCF12 and CXX876 markers. The canine chromosome 16 is known to have syntenic relationships with the human chromosomes of 4q, 7q, and 8p.