

How the Inheritance of Copper Toxicosis and CDDY/IVDD Differs

Although both Copper Toxicosis (CT) and Chondrodystrophy with Intervertebral Disc Disease (CDDY/IVDD) have genetic components, they are inherited very differently.

Copper Toxicosis (CT) is a **complex inherited disease**. For many years, breeders believed CT was caused primarily by a single gene, **COMMD1**, and that DNA test results alone could reliably predict disease. However, more recent research has shown that this is an oversimplification. This does not mean we should stop testing for **COMMD1**. Scientists have identified additional genetic variants, including variants in **ATP7B**, that also influence copper metabolism, and evidence suggests that still other genes and environmental factors, such as diet, play important roles. This explains why some dogs with similar DNA test results accumulate very different amounts of copper in their livers. As a result, CT is now recognized as a **complex, multifactorial disease**, and breeding decisions should consider DNA results, liver biopsy findings when available, family history, and emerging research.

CDDY/IVDD is different. It is associated with the presence of an extra copy of the **FGF4 retrogene insertion on canine chromosome 12 (CFA12)**. This genetic insertion has a much more direct effect on cartilage and intervertebral disc development. Dogs with one copy generally have an increased risk, while dogs with two copies have an even greater risk of developing Hansen Type I Intervertebral Disc Disease (IVDD). Although not every genetically affected dog will develop clinical IVDD, the inherited risk is directly related to the presence of the FGF4 retrogene.

In simple terms:

- **Copper Toxicosis** is a **complex, multifactorial condition** involving several genes and environmental influences.
- **CDDY/IVDD** is a **single-gene-associated trait** caused by the CFA12 FGF4 retrogene insertion, with risk increasing as the number of copies increases.
- CT inheritance is more difficult to predict because multiple genes and non-genetic factors contribute to disease expression.
- CDDY/IVDD inheritance is more straightforward because the DNA test identifies the specific genetic insertion associated with increased disease risk.

Understanding these differences is important. The same breeding strategy should **not** be applied to both conditions. CT requires evaluation of multiple sources of information, while CDDY/IVDD breeding decisions can be based more directly on the dog's CFA12 FGF4 DNA test result together with consideration of overall genetic diversity and the health of the breed population.

As our understanding of canine genetics continues to evolve, breeders should be prepared to adapt their breeding decisions as new scientific evidence becomes available. This is exactly what has occurred with Copper Toxicosis and is now occurring with CDDY/IVDD.