

CDDY/IVDD Breeds Compilation

The following is a compilation of breeds known to have CDDY with risk of IVDD. This is not meant to be a complete list but is what I could find documented. Categories are my own with the reasons dogs would fall in the stated category.

1. **Strong scientific evidence** – peer-reviewed studies demonstrating an association between the **FGF4 retrogene on chromosome 12 (CDDY)** and increased risk of **Hansen Type I Intervertebral Disc Disease (IVDD)**.
2. **Genetic evidence only** – breeds known to carry the CDDY mutation, but without breed-specific studies proving increased IVDD risk.
3. **No evidence** – breeds that have tested negative or have no documented association.

Breeds with documented CDDY–IVDD association

These breeds have published evidence that the chromosome 12 FGF4 retrogene (CDDY) is associated with increased risk of IVDD.

Breed	CDDY Present	Published IVDD Association
Dachshund	Yes	Very strong
Beagle	Yes	Strong
French Bulldog	Yes	Strong
American Cocker Spaniel	Yes	Strong
Pembroke Welsh Corgi	Yes	Strong
Basset Hound	Yes	Strong
Pekingese	Yes	Strong
Shih Tzu	Yes	Strong
Lhasa Apso	Yes	Strong
Miniature Poodle	Yes	Reported
Cavalier King Charles Spaniel	Yes	Reported

These breeds were represented in the original genome-wide association studies by Brown et al. (2017) and subsequent studies by Batchelor et al. (2019) and others.

Breeds known to carry CDDY but with limited breed-specific IVDD evidence

These breeds have the mutation but little or no published epidemiologic evidence quantifying IVDD risk.

<u>Breed</u>	<u>Current Evidence</u>
Bedlington Terrier	Mutation present; phenotype under investigation, IVDD anecdotally reported
Skye Terrier	Mutation present; biologically expected risk but limited studies
Nova Scotia Duck Tolling Retriever	Mutation identified; few clinical reports
Havanese	Mutation reported; limited data
Bichon Frise	Mutation reported
Maltese	Mutation reported
Chihuahua	Mutation reported
Yorkshire Terrier	Mutation reported
West Highland White Terrier	Mutation reported in some populations

For these breeds, the mutation has been identified through genetic testing or research, but the number of documented IVDD cases has not yet been sufficient to produce strong breed-specific risk estimates.

Breeds with the chromosome 18 FGF4 retrogene but not chromosome 12

These breeds typically have **chondrodysplasia (short legs)** but **not the increased IVDD risk associated with CDDY**.

Breed	CFA18	CFA12
Cairn Terrier	Yes	No
Scottish Terrier	Yes	No (or extremely uncommon)
Norwich Terrier	Yes	No
Norfolk Terrier	Yes	No

These dogs have naturally shorter limbs but are **not considered chondrodystrophic because of the CFA12 insertion**.

Breeds with no documented CDDY mutation

Examples include:

- Golden Retriever
- Labrador Retriever
- German Shepherd Dog
- Border Collie
- Doberman Pinscher

- Great Dane
- Boxer
- Standard Poodle

These breeds can certainly develop IVDD, but when they do, it is generally **not due to the CDDY mutation**. Instead, IVDD may result from aging, trauma, body conformation, obesity, or other genetic factors.

What this means for Bedlington Terriers

This distinction is important for your ongoing work:

- **Bedlington Terriers have documented CDDY (FGF4 chromosome 12) in the breed.**
- The **biologic mechanism** by which the mutation causes premature disc degeneration is well established across many breeds.
- What remains uncertain is **how much clinical IVDD occurs in Bedlington Terriers compared with other CDDY-positive breeds.**
- This is why current efforts to collect radiographic, MRI, clinical, and DNA data in Bedlington Terriers are so important. The question is no longer *whether the mutation exists*—that has been demonstrated—but rather *its penetrance and clinical impact within this specific breed*.

Key References (AMA)

1. Brown EA, Dickinson PJ, Mansour T, et al. FGF4 retrogene on CFA12 is responsible for chondrodystrophy and intervertebral disc disease in dogs. *Proc Natl Acad Sci U S A*. 2017;114(43):11476-11481.
2. Batcher K, Dickinson P, Giuffrida M, et al. Phenotypic effects of FGF4 retrogenes on intervertebral disc disease in dogs. *Genes (Basel)*. 2019;10(6):435.
3. Bannasch D, Dickinson P, et al. Subsequent studies evaluating the prevalence and clinical significance of FGF4 retrogenes in multiple dog breeds.

One important nuance is that **absence of a published breed-specific association does not demonstrate absence of risk**. In many breeds—including the Bedlington Terrier—the evidence gap reflects limited epidemiologic data rather than evidence that the CFA12 FGF4 retrogene is harmless.

This distinction is central when interpreting current breeding recommendations and ongoing research.

One additional point is worth emphasizing because it is often misunderstood in discussions of CDDY. The **CFA12 mutation is considered pleiotropic**, meaning a single gene affects more than one trait. In this case, the same mutation influences both skeletal development (limb length) and intervertebral disc biology (predisposition to IVDD). This is why researchers cannot separate the "dwarfism gene" from the "IVDD gene"—they are different biological effects of the same mutation. Brown et al. (2017) and Batchelor et al. (2019) both emphasize this relationship.