WHITE MARKINGS IN THE BOXER, CAUSES AND INHERITANCE: A SUMMARY

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by
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The following presents a brief summary of the genetic basis of white markings in Boxers. For those readers wanting more detail, a more full account can be found on my website (www.steynmere.com) along with a published paper on the relationship of white colour and deafness, which is primarily focussed on Dalmatians. The ultimate reference is CC Little's book, "The Inheritance of Coat Color in Dogs" Howell Book House, NY.

The gene

The gene that causes white colour and white markings in Boxers was given the name, white spotting, symbol s, by the famous mouse and dog geneticist, CC Little, who worked in the Jackson Laboratory, Maine in the 1930s to 1950s. The gene name and symbol has been changed in recent years to correspond with its action as elucidated by the new molecular biology, but I shall not use it here as it does not help explain its effects and inheritance.

Pigmentation of the hair and skin

Hair and skin pigmentation is brought about by pigment cells (melanocytes). They originate in a set of three sites on the head and six on the back and, during foetal development, migrate laterally as a 'tide' from around the eyes and ears on the head and down the sides of the body. Their spread is not always complete such that the 'tide' on the head does not always reach under the chin or all the way to the nose. And on the body it may not reach the belly or sweep all the way down the legs to the feet. The consequence is the commonly-observed white blaze on the face, the white spot on the chest, and white areas on the belly and white feet. Basically, therefore, the white areas are those where the migratory pigment cells do not reach.

Duration of the migration

Most of the migration in the dog occurs before birth but the "tide" is still on the move after birth especially on the head. Thus white markings of the face typically narrow down over the first few weeks or even over later ages, and nose pigmentation, if slow, can increase for up to a year. Hence the gradual growing in of pigmentation in 'butterfly' noses.

The genetics of white markings

There are a number of different genetic systems that cause white markings in dogs but in Boxers we only have to think about one. It is based on a single gene, the s gene, which in Boxers occurs in two different forms (alleles). The normal allele has the capital symbol, S, and this gives the dog essentially full pigmentation. Conventionally, such dogs are described as 'solid', but the derogatory term 'plain' or its alternative awful term, 'classic', have also been used. So this is the situation for the normal dog, wolf or whatever animal; it is coloured all over with the occasional spots of lack of pigmentation on chest, belly and toes. (In the UK, studies on solid Boxers have allowed the definition as "white on feet confined to the toes", irrespective of possible white on the muzzle). The alternate allele, which is really responsible for white markings is the sw allele, and this allele brings about its effect by reducing the number and/or limiting the migration of the pigment cells. Consequently, the regions at risk of being white are much bigger, so white blazes on the face, white around the neck and long white socks are typical, and at extreme the whole dog can be white or nearly so. The regions most liable to have pigment cells are typically those around the eyes and ears, and patches of pigmented hair and skin may be occasionally found in the loin region.

The inheritance of white markings

While the above descriptions might suggest a continuous range in amounts of white from near-absent in solids, through our traditional flashy Boxers, to the whites, but this is not the case. Instead, three distinct groupings can be seen and these have their basis in the s alleles they carry.

All dogs have two copies of every gene (ignoring sex-linked genes) and thus in Boxers there may be any combination of the two alleles, S and sw. The solid Boxer has two copies of the S allele. It is genetically S/S. This is the normal situation, the normal colour, as in black or yellow Labradors. Mated together, such dogs can only produce solid progeny; they breed true. Thus:

S/S x S/S produces 100% S/S

Likewise, at the other end of the scale, the white/near-total white Boxer has two copies of the sw allele. It is genetically sw/sw. This is the situation found in white dogs with occasional pigmented patches, such as the White Bull Terrier. Mated together, they can only produce white progeny; they breed true. Thus:

sw/sw x sw/sw produces 100% sw/sw

But then we have the Boxer with one S allele and one sw allele. It is genetically S/sw. This is our traditional flashy Boxer with levels of white markings intermediate between the two extremes. The amount of white is variable, ranging from the small white blaze on the face, with white chest and belly and short white socks through to wide white blaze, white colour and long white socks, or even over-marked with white over an eye or ear. Mated together, they certainly don't breed true because all three colour categories (solid, flashy and near-white) appear among their progeny. Thus:

S/sw x S/sw produces 25% S/S 50% S/sw and 25% sw/sw

The craziness of breeding Boxers

Long standing custom in the UK and US ensures that solid dogs are not favoured in the show ring. By accepted practice, and also stipulated by Boxer Club regulations, white Boxers are not only excluded from the show ring but also denied use for breeding. The flashy Boxer is therefore the demanded colour for show. It therefore makes up a majority of the show and, hence, breeding population. And as we see above, 25% of their pups will be solid, and not favoured, and 25% will be white, and excluded from everything. The result is that about 50% of pups from standard flashy show stock breeding is 'wasted' simply because of colour – and these could be the best of the litter in terms of soundness, construction and other show qualities, as well as health.

Other disadvantages of the white gene

Flashy Boxers run into a number of cosmetic problems for show because of the presence of sw.

As already mentioned, they can be over-marked:

- They can have butterfly noses;
- The distribution of white markings may be asymmetrical or may distort the over-all image to disadvantage in the show ring;
- The absence of pigmented cells that is the basis of the white markings may affect the eye resulting in unpigmented haws (one or both eyes) and even the eyeball itself, other than the iris, can be totally white to give a human-like eye, which is ugly in a dog.

And, with white Boxers:

- They can have the unpigmented eye features to extreme and even the iris may be blue or blue/brown sectored rather the normal brown;
- I'm told the bare skin areas of white Boxers are more sensitive to sunburn;
- But, worst of all, when there is an absence of pigment cells in the inner ear, the hair cells that are essential for hearing, die and the result is deafness. This can occur in one or both ears. The developing practice of keeping white pups will therefore eventually tarnish the Boxer as a breed susceptible to deafness – even though it is only the one colour class that is at risk.

What can be done?

The answer would seem to lie, first with the promotion of the solid Boxer as a show dog. This should not be a problem as there is no requirement for white markings in the Standard. Indeed, throughout central Europe there is no discrimination against solid Boxers in the show ring.

Secondly, as a successful show animal, the solid would attain greater breeding use. And, the solid Boxer has the big advantage for breeding in that no matter what it is bred to, there will be no

whites. In matings of solid x flashy Boxers, half the pups will, on average be solid, and half will be flashy. Thus:

S/S x S/sw produces 50% S/S and 50%S/sw

And were whites accepted for breeding, matings with solids would yield whole litters of flashies, with no whites and no solids. Thus:

S/S x sw/sw produces 100% S/sw

Whatever the future of Boxer show breeding, the solid Boxer has much to offer.