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Improving the implementation of animal welfare legislation in animal breeding

Part II: Preliminary analysis of problems and means of intervention in the breeding of dogs



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1 Background and objective of the study

The breeding combination that produces a potentially ill offspring is prohibited under the Finnish Animal Welfare Act. At present, there has been no effective case-law on how this part of the law should be interpreted and in what circumstances it should be applied. The Finnish Food Authority has commissioned a study on the Natural Resources Institute to find solutions to these issues. The aim of the project is to create conditions for alleviating welfare problems due to harmful breeding in fur animals, dogs and cats. The background is the information on animal welfare problems that have come to the public, with parliament heading towards the appropriations allocated to the Food Safety Authority (now the Finnish Food Authority) in the amending budget to improve the welfare of fur animals.

This preliminary report on dogs focuses on the hereditary characteristics of significant welfare factors that require the urgent implementation of the Animal Welfare Act. The aim of the study is to list these characteristics and to define and develop tools for practical monitoring of animal welfare. In addition, the aim of the study is to define limit values for situations where the Authority must assess whether there has been an infringement of the animal welfare legislation in respect of breeding and the appropriate measures in the event of infringement.

The monitoring criteria presented, including their limit values, have been designed in accordance with Finnish animal welfare legislation to the dog as a species. The control criteria therefore apply to all dogs, both pedigree dogs and mix-breeds, but the strengthening of the implementation of the animal welfare legislation relating to animal breeding must be primarily aimed at breeding animals. The criteria have been developed specifically in view of the problems of the short-skull structure, but there are also criteria suitable for a wider group of dogs, for example in the case of musculoskeletal and skin problems.

In order to allow for breeding that promotes the health of short-skulled dogs and meets the requirements of animal welfare legislation, clear methods and tests are needed to measure the severity and predict the risk of inheritance of the health problems. For most welfare disadvantages, there is already such a method.

If the welfare problems caused by exaggerated features are being tackled solely by means of health examinations without changing the characteristics themselves in a more normal direction, only the symptoms are treated, even if one should address the causes. Lasting results can only be obtained by changing the characteristics themselves, which will allow the gradual abandonment of many health studies.

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2 Animal Breeding in the legislation

Finland's current Animal Welfare Act (247/1996 ESL) provides for the breeding of animals to follow:

ESL 8 Animal breeding and genetic engineering

Animal breeding shall take into account animal welfare considerations and animal health. Such breeding or the use of breeding methods which may cause compromised animal welfare or significant harm to the health or welfare of the animal shall be prohibited.

Proposal of the Board of Directors (36/1995 HE) Detailed justification Article 8. 2 mom.

According to paragraph 2, breeding which may cause suffering or significant harm to the animal's health or welfare are prohibited. In that provision, the animal refers to both the mother animal and the offspring. The purpose of this provision is to prevent the breeding of animals whose appearance or genome results in suffering or significant harm to the animal. In addition, the purpose of this provision is to prevent the proliferation of severe births caused by inappropriate animal breeding and the emergence of permanent malformations in the offspring.

In addition to the Animal Welfare Act, this is governed by Article 24 of the Animal Welfare Act (396/1996). According to the regulation, any natural or artificial addition or breeding method which causes, or is liable to cause suffering to, or damage to the animal, shall not be used.

[The draft Animal Welfare Act](#) is intended to define harmful animal breeding more precisely and clearly (Ministry of Agriculture and Forestry 2018). The aim is to steer animal breeding in a direction that takes greater account of animal health. According to the draft law, animal breeding should aim at the production of viable, functional and healthy animals.

3 Characteristics causing suffering or significant harm in dogs

The breeding of dogs to meet human needs and preferences has a long history, as a result of which the dog has become the most diverse domestic species in appearance. At the same time, harmful traits have emerged and become more common. Some of these features have been favored in breeding because of their speciality, and entirely new breeds have been created based on them.

Harmful traits can also be increased in other ways. They may have a genetic correlation with the characteristics that breeders have been bred for. They may also be the result of a lack of proper breeding if the breeding goals are missing or prioritised in a way that is detrimental to well-being. Some characteristics have also been added excessively, gradually forming extremes that are harmful to dogs.

Inbreeding, on the other hand, increases the likelihood of harmful, recessive gene forms appearing. Inbreeding has been commonly used in dogs - first when creating the breeds and then establishing their characteristics (Lewis & Windig 2017). Today, the increase of kinship and inbreeding are caused by the closed populations of the breeds and the excessive use of certain males in relation to the size of the population.

In wild animals, the characteristics of suffering or significant harm are eliminated because they reduce the vitality and reproductive capacity of the individual. In pet animals, many of these qualities have become more common, as even weak individuals can be kept alive and reproducing because of the good treatment given by man.

The challenge for dog breeding is the fragmentation of operators and breeding goals: numerous breed associations and breeders' own preferences (Lewis & Windig 2017). These operators may be missing a common breeding programme, commitment to common breeding goals and also a phenotypic data needed in breeding (Lewis & Windig 2017). On the other hand, welfare-impaired features may even be seen as national treasures that are not wanted to be changed.

The traits causing suffering or significant harm referred to in the Animal Protection Act may be divided into those caused by a single gene and by the interaction of several genes and the environment. They are called monogenic or polygenic form of inheritance. Harmful traits are either hereditary diseases or defects, or exaggerated characteristics of the appearance or behaviour. Some of these are related to breed-typical characteristics or are themselves the breed determining characteristics (Table 1).

Table 1. Breeding tools to avoid and prevent hereditary diseases, traits and/or syndromes causing significant well-being in the dog.

Mode of inheritance	What causes		Breeding tools to prevent or improve the situation
Monogenic	Randomly occurring harmful mutations	Coincidence	Cannot be prevented
	Accumulated mutations causing the breed-typical diseases and defects	Small founder population and genetic bottlenecks, closed population, small effective population size, inbreeding	<ul style="list-style-type: none"> Increasing genetic variation in the population, breed crosses Selecting breeding combinations in a way that causes as few diseased offspring as possible*
		Breed-typical and/or exaggerated characteristics	<ul style="list-style-type: none"> Changing the breeding goals Selecting breeding combinations in a way that causes as few diseased offspring as possible*
		The issue has not been taken into consideration in breeding	<ul style="list-style-type: none"> Gathering phenotypic data of the individuals Selecting breeding combinations in a way that causes as few diseased offspring as possible*
Polygenic + environment (quantitative)	Randomly occurring harmful mutations	Coincidence	Cannot be prevented
	Accumulated mutations causing the breed-typical diseases and defects	Small founder population and genetic bottlenecks, closed population, small effective population size, inbreeding	<ul style="list-style-type: none"> Increasing genetic variation in the population, breed crosses Selecting breeding combinations in a way that decreases the number of diseased individuals in each generation*
		Breed-typical and/or exaggerated characteristics	<ul style="list-style-type: none"> Changing the breeding goals Selecting breeding combinations in a way that decreases the number of diseased individuals in each generation*
		The issue has not been taken into consideration in breeding	<ul style="list-style-type: none"> Gathering phenotypic data of the individuals Selecting breeding combinations in a way that decreases the number of diseased individuals in each generation*

*Data to support the selection of breeding dogs: individual's own phenotype, genetic testing of mutations or risk areas, information of the dog's relatives, breeding indices (for example EBVs)

3.1 Breed standards

The English Kennel Club was founded in 1873. As a result, written models, breed standards, breed definitions, were drawn up for the breeding of dogs, and breeding was formalised. Nowadays Kennel Club's practice in dog registration is applied in more than 100 countries, including Finland.

The majority of dog breeders set dogs' health and well-being as the most important criteria in breeding (Wang et al. 2018), but in some breeds the pursuit of the ideal dog described in the breed standard has been exaggerated or otherwise harmful.

The characteristic of several breeds are due to genetic changes (mutations) and should not be considered as variations of the normal structure of the dog (Nordic Kennel Union 2018). Many hereditary diseases and problems are associated with the typical appearance of the individuals in the breeds. Such problems include difficulties in giving birth, skeletal problems, skin folds causing eye damage, and structural constriction of the respiratory tract. These problems cause pain, difficulty in breathing and/or discomfort, which may also prevent normal species-specific behaviour. The background is the over emphasisation of the defined appearance features. Often the breed has changed so much over the years that its specimens no longer comply with the breed standard (The Finnish Kennel Club 2014a). In this case, the breeding goal should be to reverse back to the original type.

Some breed definitions require appearance properties that, if went to the extreme, are harmful to health. According to a study published in 2009, each of the 50 most popular breeds in England has a hereditary disease to which the description of the breed standard exposes individuals (Asher et al. 2009). As the reasons for this, Asher (2009) mentions both the breed standards themselves as well as their interpretation. Even if the breed standards do not directly require characteristics that endanger the well-being of dogs, an inaccurate description of the characteristics gives room for an interpretation that may also lead to exaggerated features (Asher et al. 2009). Interpretations of breed standards may have sometimes led judges and breeders to favour dogs of the extreme type (Nordic Kennel Union 2018).

Some of the breed standards have been corrected and refined in recent decades. However, the changes have not been big, and individuals of a clearly exaggerated appearance are being rewarded in dog shows, even in breeds where actions to safeguard the well-being of dogs is urgently needed. In some standards, there are still shortcomings and points which give room for wrong kind of interpretation (Finnish Kennel Club 2018, Nordic Kennel Union 2017).

The breed standard of each breed is managed by the breed's home country, so the standards of non-domestic breeds cannot be changed here in Finland. However, we have a chance to interpret the standards in our own way. In Finland, it is not possible to comply with breed standards or their interpretations, which are contrary to our animal welfare legislation.

4 Avoidance of suffering or significant adverse effects in the breeding

The presence of hereditary diseases and defects can be prevented by excluding the animals that transmit them from breeding. The inheritance of diseases and defects may in some cases be foreseen by examining the animal's pedigree or by examining the animal itself for illness or defect. Genetic tests are also used to determine the genetic heritage of the animal intended for breeding in relation to the disease. The characteristics favored in breeding, such as the colour of the fur, may be associated with undesirable features such as sensory deprivations or lethal factors. In the area of these defects, such breeding should be avoided, which result in the defect being inherited to the offspring (Presentation of the Animal Welfare Act, Ministry of Agriculture and Forestry 2018).

In addition to the means mentioned in the measure, suffering or significant harm can be avoided by favoring the normal canine construction in breeding and by refraining from the use of dogs for breeding whose anatomy or physiology exhibits extreme features that are predisposing to welfare damage. It is also important to avoid inbreeding.

4.1 Breeder's obligations

Not all harmful traits are visible in the dog's phenotype and predicting the inheritance of especially polygenic traits is not easy. Most of the important traits are regulated by many genes. Polygenic traits are manifested in different degrees in individuals, unlike a single-gene characteristic that the animal has or does not have. The polygenic traits are also modified by the environment within the frameworks of genes, which makes it difficult for the breeder to evaluate the genetic value of the dog. Therefore, surprises caused by hereditary diseases can never be avoided with certainty.

In interpreting the Animal Welfare Act and the future Animal Welfare Act in relation to the breeding of dogs, it is important that the breeder is able to demonstrate that he has done his/her best on the basis of existing knowledge. In order for the breeder to operate in accordance with our animal welfare legislation, he must have basic knowledge of the animal's normal anatomy, physiology, behavior, as well as breeding theory and population genetics. He must know in advance the needs of the animal species, breed and/or type (multibreed animals) he has bred, as well as of hereditary problems typically present that cause a welfare disadvantage. He shall use his best efforts to ensure that these characteristics are not passed on to the offspring. The breeder must understand how these characteristics are avoided in the breeding by means of health tests or other information from the pedigree or animal itself. He shall be able to prove that the animals he used for breeding have been properly inspected for these characteristics prior to the mating and that the results of the inspection are acceptable for breeding purposes. He must also take into account the kinship of the breeding combination and the resulting inbreeding coefficient of future offspring. His left is also to remove animals from breeding that produce sick animals for inherited reasons, as well as animals

unable to mate naturally, and females with difficulties in giving birth or difficulties in caring for offspring.

It should be noted that there are no reliable diagnostic methods or tests for all hereditary diseases and/or welfare problems. However, the breeder must take into account all known facts also in these traits/diseases when choosing breeding combinations (Finnish Kennel Club 2014a).

4.2 Activities and self-monitoring of the Finnish Kennel Club and breed organisations

Steering the breeding of dog breeds is carried out in Finland by breed associations of each breed. The Finnish kennel club, which has approximately 150,000 person members, is the umbrella organisation of these associations.

In 1984, the Finnish Kennel Club launched activities concerning breeding dogs aimed at promoting health. These include the Program for Combating Hereditary Defects and Diseases (PEVISA) and the renewed breed-specific breeding programme (JTO) introduced at the beginning of the 2000s. The PEVISA program contains tests and/or health results and measures of behaviour for breeding dogs, without which puppies cannot be registered in the breeding register. The PEVISA program also allows breeding dogs to be set a minimum age and maintain genetic variation in the breed by limiting the number of progeny to be registered to an individual dog. JTO, on the other hand, contains the criteria for the PEVISA program (a description of the breed's situation) and additional recommendations on the characteristics of breeding dogs.

The content of the JTO and the integration of the PEVISA program shall be determined by the breed organisation of each breed; The Finnish Kennel Club will be responsible for reviewing and approving the programs and implementing the requirements for breeding dogs related to the PEVISA program. The PEVISA program is voluntary for breed organisations.

In 2008, the Finnish Kennel Club Board decided that puppies born from a combination of two bobtail dogs (T-Box-mutation) were not to be registered. The decision is based on the harmfulness of T-Box mutation: the mutation is lethal in the homozygous form, i.e. usually leads to death in the early fetal period. Sometimes puppies survive until the birth, severely defective. In addition to the ban on T-Box combinations, Finnish Kennel Club board of directors made a similar decision on combinations in which both sire and dam have a so-called merle mutation of the SILV gene. In homozygous form, merle is associated with various eye development disorders or diseases.

In 2009, instructions were made for the dog show judges to avoid exaggerated breed characteristics. In 2012, a breeding strategy for all breeds came into force, including guidance on the breeding of key hereditary characteristics affecting the well-being of dogs. The breeding strategy was updated in 2018.

In 2015, the Finnish Kennel Club introduced joint Nordic guidelines to avoid exaggerated breed features (see Chapter 5.6.2). These guidelines were also updated in 2018. According to the breeding strategy of the Finnish Kennel Club, these guidelines must also be taken into account when choosing breeding dogs. Finnish Kennel Club has also hoped that the guidelines will be used in their form of the Animal Protection Act and in the interpretation of the Act (Finnish Kennel Club 2014a).

In addition to the Finnish Kennel Club, several other European kennel clubs are working in a direction that improves the well-being of dogs. However, the activities of the kennel clubs are crucially linked to the interruption of long-term work in the event of a change of decision-makers, a bureaucratic decision-making order and the varying skills of the trustees responsible for decisions in matters of breeding and well-being. According to the current rules of the Finnish Kennel Club, the breed organisation of each breed – not the Kennel Club – decides on the breeding criteria for their breed. The breed organisation consists of breeders and enthusiasts. It is therefore the responsibility of the breeders themselves to decide on the criteria, which will further highlight any lack of competence and/or the long-term nature of decision-making. For this reason, too, the requirements for breeding dogs vary very widely between breeds.

The Kennel Club has made a lot of common guidelines for breeding dog breeds. Efforts have been made to improve breeding practices in order to better support and promote the well-being of the dogs. However, progress has been slow on some welfare problems, as the most effective measures have been concentrated in the fight against diseases caused by exaggerated features, rather than on changing the characteristics themselves. In particular, there is opposition to breed crosses as well as changing extreme short-nosedness, even from the kennel clubs' umbrella organisation FCI. Some breeds in a serious situation lack the mandatory health checks for parents of registered puppies (PEVISA program), which means that, under the current rules, also offspring of dogs suffering or transmitting breed-typical health problems can be registered in the breed register of the Finnish Kennel Club.

5 Views of various parties on the hereditary characteristics of dogs causing suffering or significant harm

As early as 1963, a study was published on the main harmful properties of dogs in England (Hodgman 1963). The study was based on six-month practice data from 104 veterinarians. Twelve diseases or disorders were of particular concern, the first five of which were found to require immediate action:

- hip joint growth disorder
- dislocation of the patella
- eyelid twisting inward (entropion)
- retinal atrophy
- long palate
- skin fold inflammation
- outward rotation of the eyelid (ectropion)
- trichiasis or eyelash turning inward
- elbow joint growth disorders
- abnormal behaviour
- uterine contraction weakness
- Deafness.

All listed diseases and defects require further action.

5.1. Council of Europe resolution

[The Council of Europe Resolution on the protection of](#) pets (1995) drew attention to the appearance of the welfare handicap. Contracting parties were asked to take particular account of the guidelines for the inspection of processing operations in the following cases and to

- *maximum and minimum height or weight of dogs*
 - o to avoid exposure due to very small and very large sizes, e.g. in the bone and joint damage, permanent opens and the size of the trachea.
- *ratio of the length and height of short-limb (condrodystrophic) dogs*
 - o avoid damage to the spine.
- *short-skull or muzzle boundaries*
 - o to avoid difficulty in breathing, obstruction of the tear ducts and susceptibility to delivery difficulties.

In addition, the following problems were asked to prevent:

- *permanent open*
 - o to avoid brain damage

- *abnormal positions of the limbs* (e.g. poor angulations of the hind limbs)
 - o exercise to avoid degenerations and difficulties in exercising
- *abnormal postures of the teeth* (e.g. short jaws in brachycephalic breeds)
 - o to avoid difficulties in care of puppies and eating and
- *abnormal size and shape of the eyes or eyelids* (e.g. eyelid rotations, small, deeply sunken eyes, large bulging eyes)
 - o irritation, inflammation and degeneration, and eye outness

Finally, it was called for the breeding of animals of the following types to be avoided or completely stopped, unless it is possible to eliminate serious harm:

- Semi-lethal-bearing animals
 - o E.g. Entlebucher Sennenhund [– the choice of the example breed refers to the T-Box mutation]
- *animals carrying the harmful recessive gene as homozygous*
 - o E.g. homozygous Scottish fold cats with short limbs, spinal and tail defects due to mutation
- *hairless dogs and cats*
 - o insecurity from the sun and cold, prone to a significant decrease in the number of teeth, semi-lethal factor
- *Manx Cat*
 - o dysgeusia, susceptibility to spinal defects, difficulty urinating and defecation, semi-lethal factor
- Cats carrying the 'dominant white' factor
 - o significant tendency to deafness
- Dogs carrying a "merle factor"
 - o susceptibility to eye defects.

5.2 Finland's current Animal Welfare Act and its interpretation

In Finland's current Animal Welfare Act, there is a general requirement to prevent suffering (from appearance or genome) or a significant harm to the animal. The detailed explanatory statement to the Government's proposal mentions, for example, difficult deliveries and the emergence of permanent malformations in the offspring.

The interpretation of the Animal Welfare Act in relation to breeding has been done by the Finnish Food Authority (then Evira) in relation to at least lethal genes, more specifically the T-Box mutation. In a statement drawn up at the request of the Kennel Club, Evira stated that, in its view, the mating of the applicants of lethal genesis an animal breeding which may result in individuals with permanent malformations. The appearance or genome of such animals may be considered to cause suffering or significant harm to the animal. Evira's view was that the conscious use of this mating method is in accordance with the

Article 8 and Article 24 of the Animal Protection Decree (Evira 2008). After this the board of the Kennel Club banned the combination of two dogs carrying the T-Box mutation on animal welfare grounds.

5.3 Animal Welfare Bill

[The proposal for an animal welfare act](#) goes through harmful properties in a very detailed way. Processing prohibited under the presentation shall be such as to result in the

- the animal is unable to live a life typical of its species by its characteristics.
 - *the animal has no chance of species-typical behaviour*
 - *the animal is unable to move, use its senses or perform normal behavioural forms typical of the species concerned;*
- animal body does not function normally
- the animal suffers from long-term illnesses or defects that permanently impair the level of life and/or
- the animal has psychic extremism that reduces its quality of life.

The presentation states that prohibited properties/diseases are those which cause significant harm to the welfare of the animal. This refers, for example, to long-term diseases or properties that cause continuous or repeated pain or suffering to the animal, or which prevent the animal from moving in a species-typical manner, for example. For more information, please refer to the following:

- sensory deficiencies such as congenital or progressive blindness and deafness
- modification of the appearance of the animal which causes considerable difficulties in social behaviour between animals (e.g. removal of certain signal colours by breeding in fish species);
- structural defect or disease which means that natural reproduction is not a defect.

In addition to the definition of the characteristics of an individual animal, the proposal prohibits the use of breeding combinations which are likely to inherit diseases or other characteristics causing significant adverse effects on the offspring. Examples of such features are listed as follows:

- mental or physical impairment due to illness or other cause
- deterioration of the potential of species-typical behaviour;
- The genetic factors referred to in this provision which cause welfare-related problems may include lethal factors or inheritance factors related to certain diseases or other welfare disadvantages, such as anatomical extremism or structural weaknesses.

Examples of lethal factors:

- Lethal factors leading to the death or serious malformations of offspring, e.g.
factors found in certain tailless or bob-tail dogs and cat breeds [T-Box mutation in dogs]

- o *a gene mutation causing the muscular hypertrophy of the Belgian Blue bovine breed, causing a much larger muscle mass than normal. Due to the high muscle mass, these cattle have heart problems, among other things, and natural calving is not usually possible.*

Examples of anatomical extremism:

- a short muzzle and therefore structurally narrow airway, which may cause continuous breathing difficulties for the animal.
- Excessive skin folds (eye damage and chronic skin infections)
- Abnormal eye or eyelid size (eyelid defects, eye damage and recurrent eye infections)
 - o *For example, in the breeding of goldfish, variants have been developed where the position of the eyes leads to gradual blindness.*
- Structural weaknesses such as limb defects, abnormal dentition and permanent fontanelle in the bones of the skull
 - o *For example, in dwarf breeds, there are hereditary bite defects that are connected to a form of skull that is too short. In farmed foxes, on the other hand, there are misalignments of the legs, which have an hereditary tendency.*

Such lethal factors, hereditary diseases, as well as diseases and structural weaknesses caused by anatomical extremism, usually causing the animal to weaken physical function.

In addition, examples of defects and diseases *are mentioned that impair the animal's ability to behave in a species-specific manner or impair mental function:*

- many musculoskeletal disorders and defects
- behavioural disorders
 - o *Particularly sensitive or aggressive animals should not be used for breeding.*

Furthermore, an animal which, by reason of an hereditary structure or other defect or disease, is not capable of reproducing naturally or for which an increase in well-being is likely to cause significant inconvenience:

- an animal with, for example, an hereditary characteristic that prevents normal mating behaviour
- E.g. the physique, which is why the animal cannot give birth to its offspring without surgeries
- combination with e.g. the large size or structural extremes of the offspring prevent natural childbirth
- in such cases, the use of artificial insemination to allow the breeding of the animal should also be prohibited.

Reproduction refers to all related activities, *such as mating, pregnancy, delivery and care of offspring.*

5.4. Provisions relating to the characteristics mentioned in animal welfare legislation in other countries

There are legislations on the breeding of welfare-related characteristics in Austria, Switzerland, Australia, Belgium, Denmark, Germany, Latvia, the Netherlands, Sweden, Norway and the United Kingdom. This section only covers some of these.

5.4.1 Switzerland

The Swiss Animal Welfare Regulation (Tierschutzverordnung, TSchV) generally prohibits:

- the breeding of animals whose organs or species-specific organisms are missing or deformed by hereditary causes, causing pain, suffering or welfare damage;
- the breeding of animals with discrepancies in species typical behaviour and therefore find it very difficult or impossible to live together with animals of the same species.

Furthermore, methods of artificial reproduction should not be used to replace the natural reproductive behaviour of animals.

In addition, the breeding of dogs and cats is governed, inter alia, by the following:

- If the dog behaves too aggressively or is too sensitive, it must be removed from breeding.

Moreover, (the Verordnung des BLV über den Tierschutz beim Züchten) prohibits pairings which do not allow for the exclusion of

1. Sensory loss, in particular blindness or deafness, in the offspring or
2. Difficult deliveries due to anatomical factors.

Dwarf dogs with a weight of less than 1500 g in adult life are mentioned as individual prohibited breeding lines. In addition, hereditary characteristics or symptoms to be taken into account in animal breeding are listed, which can lead to a mediocre or significant welfare disadvantage.

Dog features include:

1. Musculoskeletal and postural maintenance
 - 1.1. Skeletal malformations, exercise disorders or paralysis.
 - 1.2. Degenerative joint changes, spondylosis (stiffening of the spine).
2. Head
 - 2.1. Cranial malformations with adverse effects such as:
 - 2.1.1. dental posture defects and deficiencies;
 - 2.1.2. the position of the eye;
 - 2.1.3. breathing capacity;
 - 2.1.4. difficulties in giving birth.
 - 2.2. Open and permanent fontanel.
3. Skin, feathers, scales, nails

- 3.1. Excess skin causing a constraint or inconvenience.
4. Eyes, hearing and tactile hair
 - 4.1. Eye failure, such as blindness.
 - 4.2. Hearing loss, such as deafness.
 - 4.3. Malformations.
 - 4.4. Cataracts.
 - 4.5. Progressive retinal atrophy (PRA).
 - 4.6. Eyeball displacement/bulge.
 - 4.7. Permanent ectropion.
 - 4.8. Permanent entropion.
5. Brain, spinal cord, peripheral nerves
 - 5.1. Coordination or physical disturbances.
 - 5.2. Paralysis, such as:
 - 5.2.1. hernia (herniated disc);
 - 5.2.2. cauda equina syndrome;
 - 5.2.3. "whooping throat" (Hemiplegia laryngis);
 - 5.2.4. dermoid sinus in Rhodesian dogs.
 - 5.3. Loss of sense of direction e.g. caused by a defect in the inner ear.
6. Behavior
 - 6.1. Due to difficulty in moving:
 - 6.1.1. oversized ears;
 - 6.2. Difficulty eating.
 - 6.3. Difficulties in reproductive behaviour.

Switzerland has imposed a prohibition on breeding and exhibition on animals produced with prohibited breeding targets.

5.4.2 Austria

The Austrian (Tierschutzgesetz) prohibits the rearing of animals if it can be presumed that they or their offspring suffer from pain, injury or fear/tenderness, resulting in at least one of the following clinical signs occurring in the offspring and having an effect on their health, or substantially impairs physiological functions or causes an increased risk of injury:

- Shortness of breath
- Abnormalities in physical activity
- Limping
- Dermatitis
- Hairlessness
- Inflammation of the conjunctiva and/or corneal of the eyelid
- Blindness
- Eye swelling (eksoftalmus)
- Deafness
- Neurological problems
- Tooth deformities

- Cranial malformations
- Anatomical forms of the body, which make natural whelping not possible.

The Law also prohibits the import, sale, brokering and display of animals with prohibited characteristics.

5.4.3 Sweden

The Swedish Animal Welfare Act has just been reformed and the new law entered into force on 1 April 2019. The law prohibits breeding that can cause suffering to an animal or offspring (SFS nr: 2018:1192). [The regulationtaksessa](#) (SJVFS 2019:28) provides for the processing of dogs and cats as [follows](#):

The use of a dog or cat for breeding is not permitted if the breeding causes harm to its own well-being or if there is a risk that the offspring will inherit disease or injury from it.

The bitch should be mated at the earliest from the second season, but not before the age of 18 months. If a bitch gives birth to two litters within 12 months, the next litter interval must be at least 12 months. A bitch may no longer be used for breeding if it has had two caesarean sections

Dogs or cats must not be used for breeding if:

- it's too scared or aggressive
- it has a disease or injury that can be inherited
- it is known to be known to be similar, i.e. homozygous with recessive disease hereditary
- it is known to be a carrier of a recessive disease (heterozygous), unless the other party to the combination has been found free from the genetic variant in question.
- the combination, based on the available data, presents an increased risk of disease or injury to offspring.

5.4.4 Norway

[Norway's current Animal Welfare Act](#) entered into force in 2010. It prohibits breeding, in which the animal transmits genes that impair the functioning of its offspring. Similarly, breeding is prohibited, as a result of which the animal's ability to carry out natural behaviour is impaired. Breeding that generally raises ethical disapproval is also prohibited.

5.4.5 Netherlands

The Animal Holders Decree changed in 2014. Article 3.4 of the Regulation concerns the processing of pet animals and

1. Breeding which damages the welfare and health of the dam or its offspring is prohibited.
2. Breeding should avoid:
 - a. the transfer or development of serious hereditary diseases and defects in the offspring;
 - b. the transfer and development of external characteristics to offspring with adverse effects on animal welfare or health;
 - c. the transmission or development of severe behavioural disorders in the offspring;
 - d. reproduction which does not occur naturally;
 - e. a quantity of litter which has a negative effect on the health or well-being of the animal or its population.
3. Dogs should produce a maximum of one litter during 12 consecutive months.

According to the explanatory memorandum, for example, artificial insemination is permitted in the case of maintaining genetic variation of a small population by means of foreign genetic material (import sperm). However, routine artificial inseminations that have increased due to breed characteristics and caesarean sections that have increased in the breed and in individuals can be considered to be in violation of the Regulation by pets.

The explanatory memorandum also highlights the responsibility of the breeder. If it had been possible to prevent the risk of welfare by appropriate measures, such as health checks on breeding animals, DNA tests or changes to the breeding programme, such breeding should not have been carried out. Breeders are expected to ensure that they have the necessary knowledge of the fundamental problems of the breeds they breed. If there is reason to believe that the breeder is aware or should be aware of these problems, or if he or she had the opportunity to infuse the animals in the event of a problem, but still implements a combination violating animal welfare, he/she is acting in contraindication to the regulation.

The entry into force of this Regulation led to expert studies on the interpretation of the Regulation in the breeding of dog breeds (van Hagen 2019) and the bambino sphynx cat breed (van Hagen & de Gier 2018). The control criteria contained in the studies will be used for animal protection control (Dutch Minister of Agriculture 2019).

5.5 Finnish Veterinary Association

The Finnish Veterinary Association (SELL) has made a number of comments on breeding and is particularly concerned about the serious health problems of short-skulled dogs. In its statement in 2017, SELL notes that *instead of appearance, well-being and health must play a key role both when buying a dog and breeding dogs. The breeding goal of short-nosed and skull breeds needs to be changed and the breeding of sick animals needs to be addressed. For ethical reasons*

the use of images of short-nosed dog breeds in advertisements and marketing should also be avoided, as the use increases the popularity of breeds (Finnish Veterinary Association 2017).

For example, sell lists short or non-existent muzzles, short legs, abundant skin folds and a disproportionate structure with short legs and long backs. It notes that breeding for appearance has caused not only respiratory problems for pets, but also painful bone, ear, eye and skin diseases.

In 2019, SELL issued a bulletin calling for action against the DVL2 mutation, the so-called for corkscrew tail mutation. According to SELL, combining two dogs carrying the mutation in question violates the Finnish Animal Welfare Act.

5.6 Kennel clubs

According to Wang et al. (2018) the main concerns of national kennel organisations are hereditary diseases and exaggerated breed characteristics, as well as in breeding and decrease of genetic variation.

5.6.1 Breeding strategy of the Finnish Kennel Club

The features listed by the Council of Europe (see Chapter 5.1) are included in the general [breeding strategy](#) of the [Finnish Kennel Club](#), which instructs to avoid them in breeding. The breeding strategy also outlines the following: *Dogs surgically corrected due to a structural defect or weakness must not be used for breeding and must be transferred to the EJ [No breeding] register. Such defects or weaknesses include, for example, exaggerated loose skin, lip and nose folds, hanging eyelids, stenotic nostrils, chondrodystrophic changes in the forelimbs, patellar luxation and abnormal bite.*

According to the Kennel Club, the new Animal Welfare Act should prohibit breeding animals with diseases due to the skeletal structure, skin folds causing eye damage and structural obstruction of the respiratory tract (Finnish Kennel Club 2014a). In addition, the Kennel Club lists the following features and things to avoid or to be taken into account:

- Nervousness, fearfulness, aggressiveness, unbalanced behavior
- Inbreeding
 - o Close relatives (parent*descendant or full siblings) may not be bred together. In addition, the breeding strategy of the Kennel Club mentions that breeding together second-degree relatives (grandparent or half siblings) is also not recommended (Kennel Club 2018).
- Diseases, defects, anatomical extremes and structural weaknesses that compromise the well-being or prevent a normal, species-specific life. For example:
 - o atopic skin problems
 - o allergies
 - o health test result of a polygenic disease classified as affected;

- o hereditary problems which are symptomatic and/or require veterinary care and/or surgery.
- o difficulty breathing (loud breathing while in place and/or in motion)
- o extreme short-skull or muzzle (causing difficulty in breathing)
- o stenotic nostrils
- o Exaggerated loose or folded skin (causes skin infections, irritation of the eyes, eyelid hanging)
- o lip and nose folds
- o Abnormal size and shape of the eyes or eyelids (clear eyelid twists, large bulging eyes)
- o Permanent fontanel
- o Strong jaw imbalance
- o accentuated long ears to cause difficulty moving normally - moving difficulties
- o Very scarce rear angulations
- o bone growth disorders and loose bone fragments
- o Chondrodystrophic changes of the forelimbs
- o patellar tendon rupture
- o patellar luxation
- o abnormal bite
- o and other unhealthy external features mentioned in the guidelines for show judges (see Chapter 5.6.2).

In addition to the above, the Kennel Club's breeding strategy (Kennel Club 2018) lists the following features:

- The breeding dog must not have diseases and defects that compromise their well-being, preventing normal life.
 - o no signs of illness or difficulty breathing or movement
 - o disease requiring regular or repeated medical treatment or special diet.
- In addition, the dog must not have a defect or a disease aggravated by pregnancy and giving birth.
- If a dog carries properties that reduce well-being or prevent a normal, species-typical life, it can only be used for breeding if a genetic test can be used to ensure that the genotype of the other party of the combination is such that the combination does not harm the descendants.
- The combinations to be used for breeding should be chosen in such a way that the genotype of puppies regarding serious hereditary diseases and individual mutations associated with breed characteristics or dog color does not cause them health problems or defects. Such mutations include alleles that cause dominant hairlessness, T-Box bobtail and ridge, as well as merle, harlequin and blue dilution.

As regards the official health examinations of the Finnish Kennel Club, the breeding strategy is consistent with the fact that the breeding use of a dog with a severe hereditary eye disease or severe skeletal growth disorders or problems may be banned (Finnish Kennel Club 2018).

On reproductive characteristics, the Finnish Kennel Club instructs in its breeding strategy:

- *Only such dogs are used for breeding, which are able to reproduce naturally and nurture their puppies.*
- *Both the female and the male must be willing to mate. Mating should not be forced.*
- *Females who, at their first litter, were unable to give birth naturally or to normally care for their offspring for no reason should not be reused for breeding.*
- *Males that are not capable of mating normally or have a deficient libido should not be used for breeding by artificial insemination.*
- *Artificial insemination shall not be used if the male is reluctant or not able normally mating.*
- *Females whose well-being is affected by mating, pregnancy or giving birth due to the extreme characteristics of the or puppies should not be used for breeding.*

Further instructions are given for artificial insemination in the Finnish Kennel Club's separate instruction for artificial insemination (Finnish Kennel Club 2017): *Artificial insemination is not acceptable when:*

- *Female or male have impaired reproductive performance*
- *Female or male has a disease or defect known to be hereditary or an exaggerated feature that prevents normal mating*
- *male or female suffers from or transmits serious hereditary disease or defects*
- *the use of artificial insemination leads to overuse of individual males and thus narrows the genetic pool.*

It is also recommended that a frozen semen is used only for females who have had at least one litter that has been naturally born from normal mating in the past.

Even in natural deliveries, there may sometimes be defects in puppies and dead or deformed puppies, which may require cesarean section. The caesarean section for such a reason is not due to the fact that the female is not able to give birth naturally (Finnish Kennel Club 2014b). In addition, the Finnish Kennel Club states that

- *Only females in a good condition can be mated.*
- *The female must be at least 18 months old at the time of the mating.*
- *Female should not have more than five litters.*

5.6.2 Guidelines for avoiding exaggerated racial characteristics

Joint Nordic guidelines to avoid exaggerated racial characteristics (RKO) include a list of characteristics to be viewed in dog shows. The guidelines are based on extensive cooperation between show judges, breed organisations and veterinarians, as well as on statistics from companies granting animal insurance.

The guidelines pay particular attention to the exaggerated characteristics of dogs and to breed-specific risks that compromise the normal structure and health. According to breed guidelines, show judges should not highly reward dogs with exaggerated or sick breed characteristics in dog shows.

The list of features to be examined applies to all breeds in which these features occur. In addition, 41 breeds have been mentioned [in the guidelines updated in 2018](#), requiring particular attention from the exhibition judge. Among other things, there are short-skulled breeds, dwarf breeds, very large-sized molosser breeds and breeds with exaggerated changes in the longitudinal growth of the bones. Breed-specific exaggerated features may relate to, for example, the structure of the dog, behavior, movement, eyes, ears, skin folding or the amount of fur (Nordic Kennel Union 2018). According to the instructions, all dogs must be able to breathe normally, even when moving. They should not have problems with the eyes, bites or teeth, skin and fur, movements or behavior.

Risk targets to be monitored:

- Heavy breathing; clearly loud breathing; difficult breathing; forced, strong-snoring breathing
- Very heavy, low-carrying head
- Skull that restricts the upper respiratory space too small
- "Apple head" and tendency to concave muzzle back; too short and rounding skull
- Extremely short muzzle
- Narrow, flattened, small or even partially skin folded nostrils (the dog must have normal, sufficiently large nostrils)
- Exaggerated head skin; strong slapping of skin covering the nose; skin folds around the eyes; loose and/or too strong or twisted eyelids; too rich lips; lower lip between teeth and/or twisting; skin folds around the anus
- Irritated skin and/or folds, discolouration
- Protruding eyes (shallow orbital)
- Signs of irritation in the eyes: abundant lacrimation, crackling, brownish stain under the eye; wet edges of the moles; redness; repeated squinting and blinking of the eyes; frosted, pigmented or cloudy cornea
- Very small and very deep-settled eyes
- Too small an eyehole
- Exaggerated long ears
- Extreme dwarf growth, resulting in general frailness that impairs vitality and causes poorly developed musculoskeletal system
- Skull fontanel
- Thoracic malformations: shortened or open chest, very short sternum, unformed ribs, very narrow thoracic
- Oblique mandible; limp, paralyzed tongue

- Error-positioned teeth; signs of injury, irritation or damage to the gums; jaws that do not close normally; narrow lower jaw, allowing the canines to sag into the palate
- Arduous and unhealthy movement
- Fur, which, because of its abundance, is detrimental to the dog's well-being and its ability to move freely in its daily life
- Exaggeration of chondrodystrophy characteristics, causing severe skeletal malformations and unhealthy movements; poorly built front and asymmetry, as well as insufficient ground clearance
- Curved forelimbs, weak middle-handed; paths not applicable to the ground; over-the-top wrist (goat's foot)
- Extremely short neck and frame and rope back
- Over-angulated, clamped back; unstable hocks; upper line that descends sharply from the hip and pelvis; excessively high back and very steep pelvis; incomplete hindquarters, luxating knees and hocks
- Stiff tail, tightly turning on the anus; inwards or very tightly rotating tail
- Nervousness, severe fear reactions, panic-like escape reactions
- Uncontrollable aggressive behavior.

6 Most urgent issues requiring change in dog breeding

A method of classification may be used to determine and rank harmful characteristics requiring the implementation of animal welfare legislation, based on a similar method used in human medicine. The three most important indicators for determining the importance of hereditary diseases are the intensity of symptoms, the duration of the disease and the prevalence of the disease in the population (Asher et al. 2009; Summers et al. 2010).

The method described by Asher (2009) and Summers et al. (2010) classifies diseases and defects based on their prognosis, treatment and possible complications (Table 2). Every disease is expected to be treated in the best possible way. Account will also be taken of their impact on the quality of life of the dog. Each of these four factors has a five-point scale, where 0 is the least serious and the 4 most serious. The final severity class of the disease is obtained by adding the scores of the prognosis, treatment, complications and quality of life classifications, resulting in a minimum of 0 (least serious diseases) and a maximum of 16 (the most serious diseases).

For the prognosis, in class 0 are diseases that are rapidly and completely healing. In category 4 there are diseases that cause immediate death, either by themselves or by the euthanasia they cause.

Treatment category 0 includes diseases that do not require treatment due to their minimal health effect, and category 4 includes diseases that cannot be treated or treatment is only prolonging life span and easing symptoms. Also, diseases requiring major surgery, as well as diseases causing chronic, inconvenient pain, are in class 4.

With regard to complications, in class 0 are diseases that do not involve other diseases, and in class 4 there are diseases that predispose to a very serious condition. In the quality of life classification, a value of 0 is given for diseases that do not harm the keeping of the dog or the sociality, exercise, digestion or defecating of the dog. In the case of diseases in category 4, at least four of the above issues have become more difficult or disturbed.

In the classification, it can be taken into account that the disease can have different forms of severity. If necessary, each disease can be classified according to both its mildest and most severe levels. In some breeds, the majority of sick dogs have the mildest form of the disease, while in others the more serious form of the disease is common, so that the classification of the same disease is different in different breeds.

The prevalence of the disease in the breed also affects its importance in breeding. There is little information on the prevalence of many serious diseases. If the prevalence is known, it may be taken into account in determining the significance of the disease. For well-being, the most important hereditary diseases are those that rank in severity class 16 and are the most common.

Collins et al. (2011) took the study a further step forward in the classification of diseases, adding to the severity classification not only the prevalence of the disease, but also the share of life consumed by the disease.

Until there is comprehensive research data on all hereditary diseases in dogs, risk assessment is often specific to the disease, and it is not easy and unambiguous to set breeding priorities. The prevalence and impact of the most studied diseases on the quality of life of the dogs is the most frequent and more accurate in the assessment of the risks.

A large part of the harmful properties recorded in Chapter 5 are extreme features of the structure and appearance. In this respect, the quality and intensity of the welfare disadvantage varies according to the characteristic and the extent to which the trait differs from the normal characteristic of the species. In breeding, the normal life-functions of dogs must be ensured: free breathing, natural reproduction and a structure that allows for a physical life (Asher et al. 2009; McGreevy and Nicholas 1999, Summers et al. 2010, Collins et al. 2011).

In view of the above, the most serious and widespread welfare handicaps can currently be attributed to exaggerated short skull, i.e. exaggerated brachycephaly.

It is often called brachycephalic syndrome. The syndrome can be divided into organ specific subspecies, such as brachycephalic obstructive airway syndrome and brachycephalic ocular syndrome. Exaggerated brachycephaly exposes the dog to many hereditary defects and diseases that affect the quality of life and cause significant suffering and harm. It compromises the well-being extensively by affecting, among other things, the animal's respiratory ability, teeth, reproduction, and the health of the eyes, skin and digestive tract.

Table 2. The severity classification of diseases in dogs (Generic Illness Severity Index for Dogs, GISID; Asher et al. 2009).

Prognosis				
Short isolated bout and return to normal	Medium length isolated bout or successive short bouts and return to normal	Extended bout and return to normal or successive short bouts and minor long-term impairments	Unremitting or chronic illness or bout(s) with major long-term impairment	Imminent death as a direct result of condition or condition-related euthanasia
0	1	2	3	4
Treatment				
None required or not necessary as minimal impact on health	Medical - immediate curative &/or Surgical - single curative surgery Side effects - none or very minor, short-term	Medical - short-term curative or medium-term manageable &/or Surgical - single curative intracavity surgery/ repeated minor surgery Side effects - minor	Medical - long-term curative or long-term manageable &/or Surgical - deep intracavity surgery/ repeated minor surgery Side effects - manageable pain or moderate	None available or Medical - prolonged palliative treatment &/or Surgical - major deep intracavity surgery Side effects - chronic intractable pain or major
0	1	2	3	4
Complications				
No linked disorders	Predisposition to minor secondary condition	Predisposition to moderate secondary condition	Predisposition to major secondary condition	Predisposition to catastrophic secondary condition
0	1	2	3	4
Behaviour				
Maintenance	Ingestion	Elimination	Social	Locomotion
None of the above disturbed	One of the above disturbed	Two of the above disturbed	Three of the above disturbed	Four or more of the above disturbed
0	1	2	3	4

6.1 Contributions and policies related to exaggerated short cranial shape

In 2015, the Swedish Veterinary Committee sent an open letter ("Trubbnosuppropet") on the problems of short-skull breeds to the Country's Ministry of Agriculture. Comments on veterinarians' concerns have also been published in Germany, the Netherlands, Switzerland, England, the USA, Portugal and Finland. The world small animal veterinary association (WSAVA) in Copenhagen in 2017, where a stand was launched with a statement on the title "Vets must be dare to speak". The welfare problems caused by exaggerated short-skulls have also been launched in the global veterinary campaign [Vets Against Brachycephalism](#).

The Nordic Kennel Union (PKU) has dealt with the respiratory in a special working group and a report, which was finalised in 2017 and contains opinions and development proposals (Nordic Kennel Union 2017). The report has been produced in cooperation between the Kennel Clubs of Finland, Sweden, Norway and Denmark. The report concludes that the widespread incidence of symptoms associated with upper respiratory obstruction (brachyphalic syndrome (BOAS) is a serious welfare problem. BOAS reduces the health and well-being of the dog. The report reports that the basis of various surveys and claims from insurance companies can be found that in some short skull breeds, there are significant symptoms of upper respiratory stenosis in a significant proportion of individuals. The report lines that the situation of England Bulldog, French Bulldog and Pug requires immediate action.

The Finnish Veterinary Association and the Finnish Veterinary Practitioners (2018) state in their comments that many of the diseases caused by brachycephaly can be corrected and/or treated and therefore the individual's quality of life can be improved by veterinary methods. Repairs of structural defects to further health and caesarean sections allow further processing. However, veterinary treatment should not be a normal course of action, but only an exception. The use of sick individuals in breeding must be stopped (Finnish Veterinary Association and Finnish Veterinary Practitioners 2018). In May 2019, the Finnish Veterinary Association published in chapter 5.5. the said statement, in which it requires the breeding of three short-skulled breeds (English bulldog, French bulldog and Boston terrier) to be discontinued in its form, as they are homozygous regarding the DVL2 mutation causing extensive developmental disorders.

7 Brachycephalic construction

Dog breeds can be divided into three categories according to the shape of the head: long-skulled (dolichocephalic; the snout part of the head is longer than the skull part, for example greyhound and smooth-haired collie), intermediate (mesocephalic; the snout part of the head is the same length as the skull part, for example the Great Dane and Bernese mountain dog) and short-skull (brachycephalic; the snout part of the head is shorter than the skull part, for example, a pug; (See Figures 1 and 2). The side profile of the extremely short-skulled head is almost flat at the muzzle; there does not seem to be any muzzle.

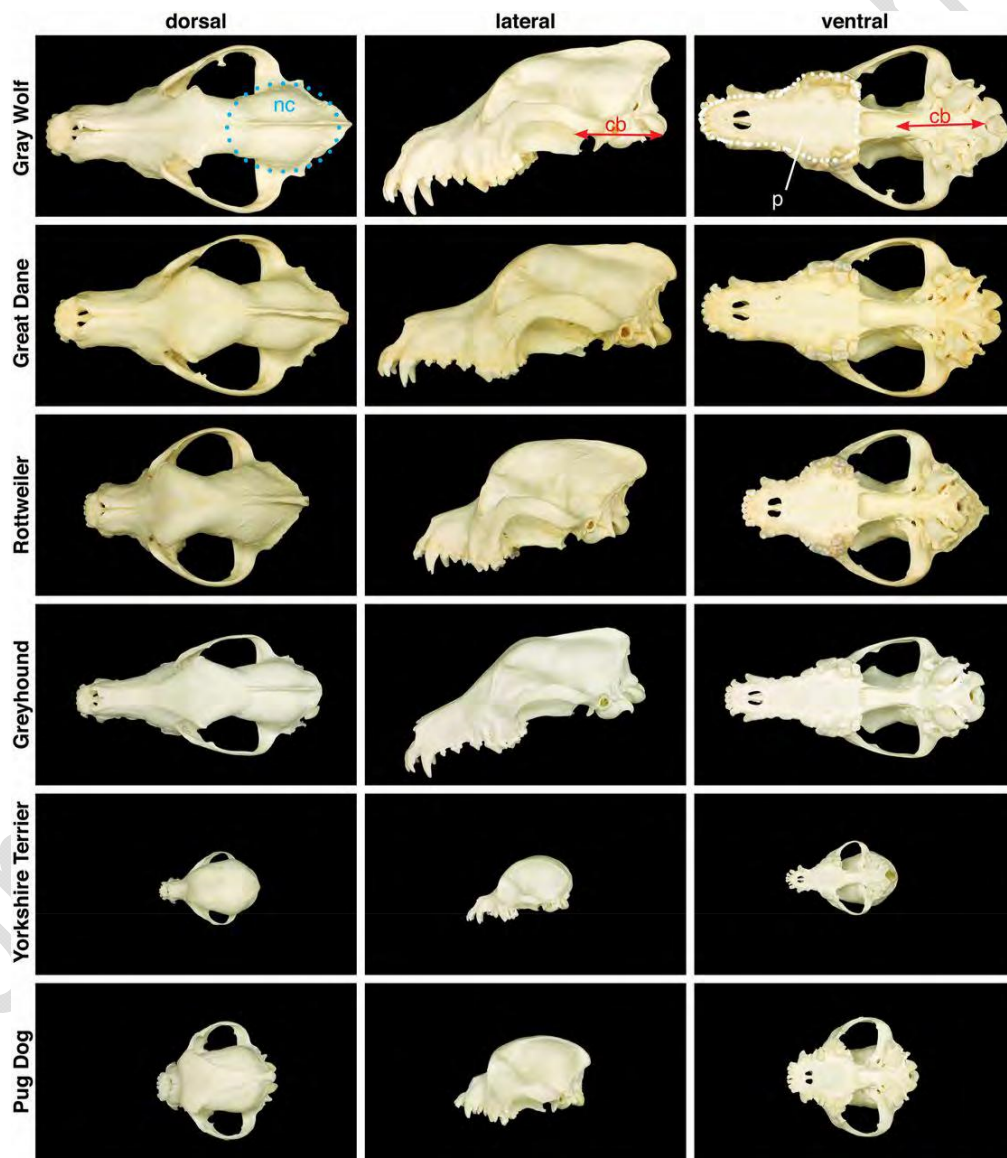


Fig. 1. Variation in skull shape between different breeds of dogs, including a grey rose. From above, a grey rose, a Dane, a rottweiler, a greyhound, a Yorkshire Terrier and a pug. Photo source: Schoenebeck & Ostrander 2013.

The brachycephalic structure therefore means a short skull and a short, immature muzzle. Such a structure of the skull is caused by mutations that affect the growth of the bones of the skull and lead to their shortening. Although the bones of the skull have been shortened, the amount of soft tissue inside the skull has not decreased proportionally. The skull is cramped, and soft tissue may clog the airways and cerebellum protrude back into the neck opening of the skull.

In humans, short skulls are defined as developmental disorders. Even in animals, it does not occur in the wild. In pets, brachycephaly is the result of a human effort to strengthen the desired physical characteristics. The short-skulled dog breeds were originally bred to fight bulls (bulldog) and the short-skulled jaw was thought to be an advantage here: the lower jaw is longer than the upper jaw, and it was thought that the dog could breathe better when it hangs onto the bull.

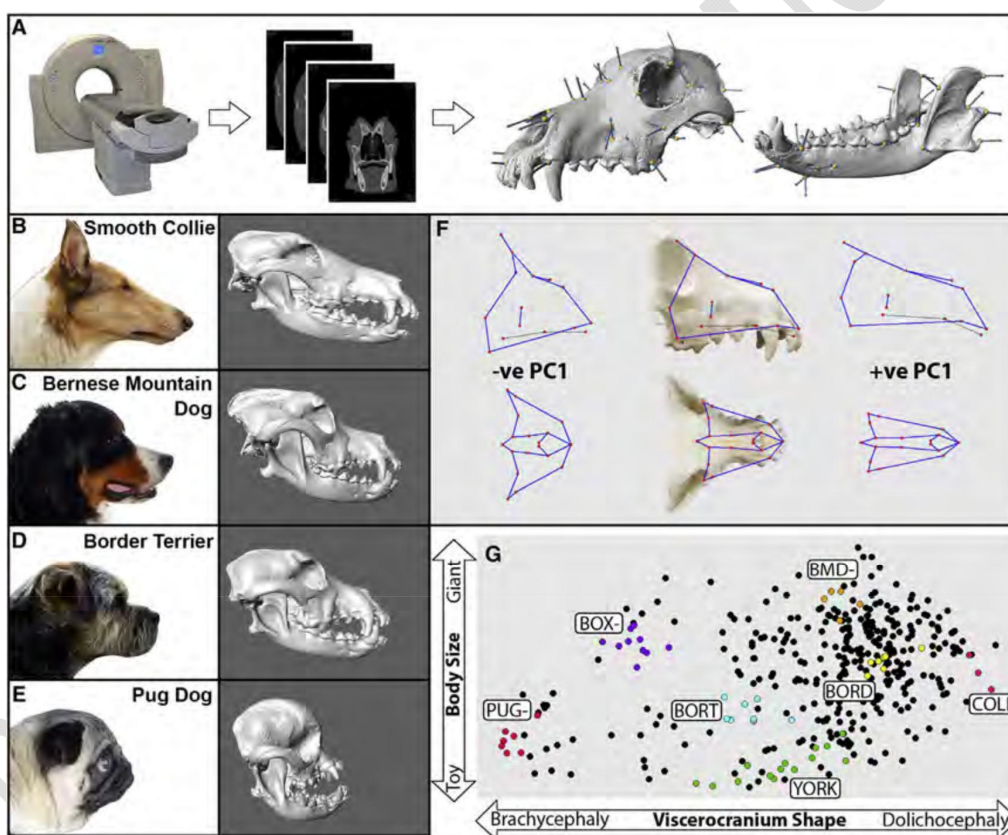


Fig. 2. Skull proportions with smooth-haired collie (B), Bernese mountain dog (C), border terrier (D) and pug (E). Photo source: Marchant et al. 2017.

Later, short-skulledness has evolved so extreme in some breeds that it has started hampering the functionality of the dog. Also in cats short-skulled breeds have been bred, for example the Persian.

7.1 Mode of Inheritance

The structure of English bulldogs, French bulldogs and Boston terriers is mainly caused by a single genetic change (mutation) in the DVL2 gene (Mansour et al. 2018). Mansour et al. (2018) study indicates that this mutation affects not only the skull but also the limbs and vertebrae. Due to the unformed vertebrae caused by the mutation, also the tail is short and immature and twists into a so-called corkscrew. Some dogs don't have a tail at all. The deformity of the vertebrae is also typically found elsewhere in the spine.

The normal functioning of the DVL2 gene is very important in individual development. Mutations in the same family of genes in humans cause very rare, the so-called Robinow syndrome, whose external symptoms of skull, limb and spinal malformations are similar to those seen in dogs (Mansour et al. 2018). Other abnormalities also occur in patients with Robinow, which have not yet been studied in dogs.

The manifestation of the DVL2 mutation is recessive: abnormalities are evident only when the dog receives a mutation from both its father and mother. In this case, the dog is homozygous. Mansour et al. (2018): the DVL2 mutation was found as homozygous (two incorrect copies) in all Bulldogs and French bulldogs, as well as a very common in Boston terriers. The mutation is the only allele in English bulldogs and French bulldogs in that gene, i.e. in these breeds normal gene form cannot be found. In Boston terriers, 6% of all alleles in the breed were normal.

The determination of the appearance of the three breeds on the basis of a single mutation is also supported, for example, by images of crossbred dogs presented by Stockard (1941), in which the external characteristics of the English bulldog disappear almost completely in the first generation when crossing with other breeds (Figure 3).

The English bulldogs, French bulldogs and Boston terriers are practically fixed by the DVL2 mutation, but mutation allele have also been found in other breeds. Information on these breeds is currently being collected in a study by the University of Helsinki studying the more precise impact of this mutation on dog development (Lohi and Hytönen, oral communication 4.9.2019). According to preliminary results, the role of the DVL2 mutation in bone development may be more limited than described in the original study. It is likely that "bulldog traits" are not only due to the DVL2 mutation, but to a number of fixed mutations (e.g. SMOC2, BMP3, FGF4). In any case, exaggerated bulldog-like features cause serious and diverse welfare and health problems.

In addition to the DVL2 gene, other cranial gene forms have been found in the genes BMP3 (Schoenebeck et al. 2012), SMOC2 and FGF4 (Marchant et al. 2017). The SMOC2 mutation explained 36% of all variation in the length of the dog's skull and muzzle (Marchant et al. 2017). With English bulldog and French bulldog, the mutation of the SMOC2 gene is the only allele of the breed in that gene. In Boston terrier, the frequency of the mutation allele was 90,3 % (Mansour et al. 2018). Similarly, the allele frequency of the BMP3 mutation was either fixed or very high in these breeds.

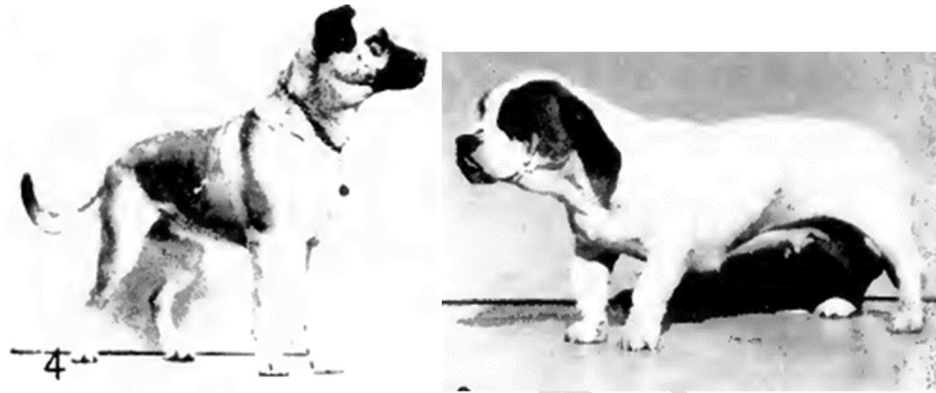


Fig. 3. On the left, the descendant of the German Shepherd and English Bulldog, on the right, Basset Hound and English Bulldog F1-generation cross. Image source: Stockard 1941.

7.2 Welfare disadvantages

7.2.1. Respiratory and temperature control system (brachycephalic syndrome, BOAS)

The exaggerated short skull is strongly linked to respiratory deformities such as cramped nostrils, pinched nostrils, too long and thickened soft palate, a transverse larynx, enlarged tonsils, and incomplete trachea and pulmonary tubes. These malformations endanger the normal functioning of the animal's respiratory and warming system (Oechtering 2010). These can all occur in dogs at the same time, but not necessarily. The condition is called upper respiratory tract syndrome or upper respiratory tract stenosis (brachycephalic obstructive airway syndrome or BOAS; brachycephalic syndrome).

There are differences in risk between short-skull breeds, and within the same breed the frequency and severity of symptoms vary between dogs. The three breeds at greatest BOAS risk are pug, French bulldog and English bulldog (e.g. Packer et al. 2015, Njikam et al. 2009). O'Neill et al. (2015) in the study the dogs of the three breeds were 3.5 times susceptible to upper respiratory problems compared to the lower race (Yorkshire terrier, border terrier and west highland white terrier). In pugs, French bulldogs and English bulldogs, upper respiratory problems were 22.0% of dogs, compared with 9.7% in control breeds. The study was based on veterinary material.

Part II: Preliminary analysis of problems and means of breeding dogs

In a health study of the Clinical Equine and Small Animal Medicine Department of the Faculty of Veterinary Medicine of the University of Helsinki and the 28 English Bulldogs and Kennel Club of England, all dogs examined had at least mild upper respiratory symptoms. The symptoms of four dogs examined were classified as serious. The stress test was passed by 29%, i.e. eight dogs (Lappalainen et al. 2017). The accepted result required a 1000 m walk within the 12-minute target period so that the dog recovered from the strain within 15 minutes.

The risk factors and disadvantages of brachy respiratory syndrome are described in the li-senate study of Nikkilä (2017).

Soft tissues of an exaggerated short-head head do not shorten the bone in the same proportion, making soft tissues, especially the tongue, soft palate and tonsils, relatively large and take up more space than normal in the upper respiratory tract, partly blocking them (Harvey 1989, Packer & Tivers 2015). Also, nasal cortex can squeeze the nasopharynx, because there is no room for them in a short nasal cavity.

The palate of the German shepherd's palate is usually about five millimeters thick, while English bulldog can have a palate of up to 25 mm (Oechtering 2011).

In addition to anatomical factors, the risk of disease has been identified as affecting the respiratory safety tendency, which has been identified by the mutation of the *ADAMTS3* gene in Norwich terriers (Marchant et al. 2019). All eel also appeared in the research material in English bulldogs (frequency 85%), French bulldogs (12%), Staffordshire bull terrier (12.5%), mittelspitz (6%) and Pomeranian (6%). The frequency of the Norwich terriers was 57%.

Short-skulled dogs have a thinner diameter trachea compared to normal-skull dogs. The narrowness of the trachea poses additional challenges for soothing short-skulled dogs compared to normal-skull breeds. As the diameter of the trachea decreases, the pressure on the tissues caused by the air passing through it increases and causes a strong back and forth movement of the pharynx, trachea and chest as the dog breathes. The tissues do not withstand the violent back and forth movement and are strained. Overtime, the continued strain of tissues can lead to serious health problems, such as the compression of the trachea (Oechtering 2011).

The above factors prevent the free flow of air in the airways, thereby preventing adequate gas exchange.

The length of the muzzle has a decisive influence on the dog's ability to regulate its body temperature. The thermoregulation mechanism of the starling of dogs is a very warped mucous membrane of the nasal cavity. In a long-nosed dog, the surface area of the mucous membrane is equal to the entire body of the dog, and its blood circulation is directly linked to the blood vessels of the brain, thus regulating the temperature of the brain. The shortened muzzle reduces the surface area of the mucous membrane needed for thermoregulation. A very significant air flow through the nasal cavity also runs in the dog's eye. Short-skulled dogs are more sensitive to high temperatures in the environment than normal snouted dogs. They overheat

i.e. are more sensitive to heat stroke. They also have a recovery period that is clearly longer than normal snouted dogs.

Lilja-Maula and others (2017) In their study to English bulldogs, the return of dogs after the gait test was assessed every five minutes until the dogs had returned to sa-earth status as before the strain. Factors to measure included heart rate, respiratory rate, body-temperature and general condition. The study found that English bulldogs with more severe upper respiratory symptoms recovered more slowly than those with mild symptoms (Lily-Maula et al. 2017).

Due to reduced resistance to exertion, even a slight amount of enthusiasm or other stress can lead to breathing difficulties. Both positive reactions, such as playing, and negative reactions, such as stress, can cause a respiratory distress attack, which can at worst lead to even death. Breathing difficulties are accentuated in warm weather and during physical activity (Hendricks 2004, Packer et al. 2015, Packer & Tivers 2015).

If the nasopharyngeal airway is cramped, the dog will have to constantly breathe through the mouth. It pants almost all the time, and its sleep is intermittent, as dogs cannot breathe through their mouths when they sleep. The dog therefore has to wake up constantly or, alternatively, to sleep, for example, with a stuffed toy in the mouth to keep its mouth open.

Clinical signs worsen as the dog ages and are typically severe at 12 months of age (Roedler et al. 2013). In some individuals, symptoms occur later, at the age of 2-3 years (Meola 2013).

BOAS makes it difficult for the animal to move, and immobility predisposes to gaining weight. Obesity is one of the risk factors for upper respiratory syndrome (Liu et al. 2017, Packer et al. 2015).

BOAS has been a recognised disease for decades and surgical methods have been developed to treat it since the 1940s. Some respiratory malformations can be corrected by surgery, but normal temperature control ability cannot be built by surgery. Sometimes the symptoms return despite the surgery.

In the case of breathing problems, it is always a question of problems that pose a threat to the life of an individual and must therefore be taken very seriously.

7.2.2 Gastrointestinal tract

When breathing through the mouth, the dog swallows air into its stomach. Swallowing the air can cause flatulence and regurgitation. Regurgitating the stomach raises gastric acids to the pharynx, which chemically irritate the dog's tonsils and vocal cords (Oechtering 2011).

The majority of dogs with brachycephalic syndrome also have anatomical or functional changes in the gastrointestinal tract (Reeve et al. 2011, Lecoindre & Richard 2004). In their study, Lecoindre and Richard (2004) found that esophagitis, or inflammation of the esophageal mucosa, was the most common gastrointestinal symptoms. Esophagitis was detected in 83% of dogs suffering from upper respiratory tract syndrome and gastrointestinal symptoms. In the second study, gastritis was the most common histological change observed in dogs with upper respiratory tract syndrome at 98% of upper respiratory tract syndrome. The severity of respiratory problems is associated with the severity of gastrointestinal problems (Poncet et al. 2005).

7.2.3 Musculoskeletal system

According to current knowledge, homozygous DVL2 gene change is expected to cause cranial, spine and limb developmental disorders and the resulting welfare problems (Mansour et al. 2018). In short-skulled dogs, both the complication of this mutation and other significant musculoskeletal problems occur, such as hip and elbow joint growth disturbances, knee joint dislocation, and cruciate rupture.

Vertebral malformations associated with the DVL2 mutation

In the case of DVL2 mutation, the tail and sacrum of identical (homozygous) dogs consist of deformed vertebrae, which is why the tail is twisted, very short and rigid. Vertebral malformations include semi-vertebrae, butterfly vertebrae, fused vertebrae, intermediate vertebrae and spina bifida, and may occur simultaneously (Anttila 2016). In addition to the "type breeds" of the DVL2 mutation, also pugs commonly contain deformed vertebrae.

In dogs with corkscrew tails, almost the entire chest and lumbar spine may be deformed in connection with the tail. In these dogs, the most common developmental vertebral dysfunctions are semi-vertebra (hemivertebra) and butterfly vertebra (vertebra, which in the picture taken on its back resembles a butterfly) (Lappalainen 2017).

Vertebral malformations are often side effects of X-ray images, but can cause neurological symptoms of varying degrees in dogs (Palm 2016). Pains or neurological problems occur if deformed vertebrae weigh on the spinal cord. Such a back is also more prone to accidents than normal. Deformities causing corkscrew tail can also cause an error position, which can lead to stool problems or skin lesions (Lappa-2017).

Frequency of vertebral malformations associated with DVL2 mutation

Anttila's thesis (2016) mapped out the congenital vertebral anomaly (VA) of the Boston Terrier. There were 61 dogs. In all dogs in the study, at least one deformed vertebra was observed in the spine.

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The most common finding in X-rays was the half-vertebrae, which was observed in 97% of the dogs enrolled. The incidences of other changes were 60% in the butterfly vertebrae, 35% for intermediate vertebrae, 25% for spina bifida and 22% in the vertebra. The most common altered vertebra was the 8th vertebra of the thoracic spine. Spondylosis occurred in 46% of dogs. A clear positive correlation was observed between spondylosis and vertebral changes, which means that vertebral malformations are likely to predispose to spondylosis. A negative correlation was observed between his length and vertebral changes, i.e. the shorter the tail, the more vertebral changes.

Palmu's (2016) thesis was part of the study of the Kliininen Department of Veterinary and Small Veterinary Medicine of the Faculty of Veterinary Medicine of the University of Helsinki, as mentioned in section 7.2.1, and the English Bulldog Association and the Finnish Kennel Club, which was intended to clarify the health of English bulldog. A total of 28 English bulldogs participated in the study. Unformed vertebrae were observed in 82% of dogs. The most common vertebral malformation was butterfly vertebrae. Malformations were directed at the thoracic region, where the second one was the T9 vertebra. The incidence of spondylosis was 89%. In this thesis, a statistically significant relationship was observed between spondylosis and vertebral malformations. It is true that due to the unstable structure of the deformed vertebra, spondylosis are formed to support this structure, but the final formation of spondylosis may also be accompanied by other factors (Palmu 2016).

Back changes are also very common with French bulldogs, for which, in addition to deformed vertebrae, are also characterised by disc degeneration. Degeneration of the discs is linked to the 12 FGF4 retrogen of the chromosome, which is commonly found in dachshund and French bulldog, but also in many other dog breeds as well as in mixed-breed dogs (Batcher et al. 2019). Batcher and Others v Commission (2019) the retrogen has a dominant effect, increasing the risk and reducing the age of occurrence of the disease.

According to the kennel club's breeding information system's cause of death statistics, back disease is the most common cause of death and killing of French bulldogs (100/622 dogs, or 16%; dogs that died in 2010-2019). The average age of these dogs was five years.

In addition to vertebral malformations, other skeletal stances were examined in the health assessment of the English bulldogs. About one in three dogs lyrical. 58% had severe hip replacement growth disorder (Grade E) and 8% had severe elbow joint growth disorder (Grade 3). Dislocation of the patella was common (Lappalainen et al. 2017).

The frequency of hereditary back changes and the results of other bone tests can be viewed from the Kennel Club's breeding information system (jalostus.kennelliitto.fi).

7.2.4 Teeth and mouth

In short-skull dogs, the longitudinal axis of the skull is shortened (Evans 1993, Meola 2013) and the length of the bones in the skull is insufficient. The relative lengths of the jaws have changed and non-maxillary jaws also affect tooth placement. The number of teeth is

same as in mesocephalic and dolichocephalic dogs. In addition, small dogs have mouthful teeth relative to the size of the jaw. These factors, especially in small short-lived dogs, lead to developmental disorders of the head and mouth structures, various dental diseases, and improper bites, in which the teeth of the upper and lower jaw do not meet each other normally. The teeth do not always fit properly in the short jaw and may twist and/or move to the locale.

Dental problems in short-skulled dogs also include the integrity of milk teeth, only partially punctured teeth, dental cysts and progressive periodontitis (e.g. Fox 1963, Meola 2013).

7.2.5 Eye and eye tissues

Eye diseases due to exaggerated short form of the skull are sometimes called ocular brachycephalic syndrome (BOS). This syndrome develops various ocular malformations, such as:

- exophthalmos: the eyeball protrudes outwards due to a shallow or narrow eye hole.
- macroblepharon, i.e. too large gap in the eyelids relative to the size of the eyeball.
- lagophthalmos: the dog cannot properly close its eyelids (Maggs et al. 2008, Crispin 2019).

These features are prone to dog dryness and corneal injuries, for example.

The Finnish Kennel Club's RKO guideline (2018) covers predisposing features: *Examples of possible injuries: Skull anatomy, eyeball position eye-spawning, eye shape and wrinkles on the head and rich leather around the eyes. Folds and wrinkles of the muzzle part or head can come into contact with the cornea and cause irritation and damage.*

The characteristics of short-skull breeds are mentioned as follows: *short and wide skull, short muzzle and muzzle, loose leather on the head, skin folds and long (very open) eyelids can cause dryness, injuries and inflammation of the eye.*

The eyeball position is affected by the eye socket: it can lead to either deep and protruding eyes. If the eye is located too deep, the eyelid may rotate inward (entropion). The wide skull increases the risk of entropion at the outer corner of the eye.

Protruding eyes are caused by a shallow eye socket and are more prone to damage, especially if, in addition, the muzzle is short and the nose close to the eyes, between them. Abundant leather and hair near the eye can irritate or damage the surface of the eye, especially if the eye is protruding. This often happens if the muzzle is short. Thick, heavy wrinkles in or around the face, as well as heavy lips and eyes, can distort the shape of the eyelid.

Due to the underdeveloped, exaggerated short muzzle, excess skin forms a deep fold on the nose (Figure 4). With the nasal fold very pronounced and the muzzle very short, the hairs of the nasal fold can hit the surface of the eye (nasal fold trichiasis; Jalomäki and others. 2016).

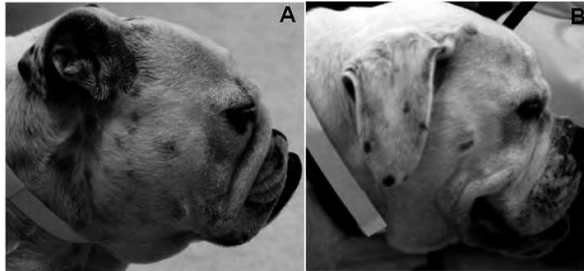


Figure 4. An example of a male with a significant nasal fold (A) covering the nose and a longer-muzzled dog without such a fold (B). Photo source: Packer et al. 2015b

Medial caruncular trichiasis is a typical problem in short-nosed breeds, where the hair of the skin of the muzzle angle extends very close to the eye, and the hairs are directed to the eye. Hairs cause similar symptoms to entropion. If the hairs hit the cornea, as is usually the case with nasal folds, they often cause more severe symptoms than when hitting only the conjunctiva.

In dogs with a nasal fold similar to the above, corneal ulceration occurs almost five times as many as in dogs without nasal fold. In dogs with a relative muzzle length of less than 0.50, corneal ulcers occur 20-fold as compared to mesocephalic and dolichocephalic dogs (Figure 5).

Entropion is the most commonly inferior position, in which the mole rotates inward, causing irritation of the surface of the eye when the hair/ skin of the eye hits the surface of the eye. A typical symptom is tearing the eye because of the feeling of rubbing. In short-nosed dog breeds, entropion is most commonly found in the lower eyelid of the muzzle, and the opening of the lower eyelid also twists in too much, and thus does not drain tears normally. This increases tears (Jalomäki et al. 2016). At worst, twisting causes ulceration of the cornea of the eye and thus severe pain. In addition to tearing, redness and squinting of the eye occur. At its mildest, entropion does not cause any visible symptoms. The longer-running irritation of the cornea leads to pigmentary keratitis, which is inhibited especially in short-nosed dwarf-breed dogs (Jalomäki et al. 2016). The prevalence in pugs in British data was 193/210 (91.9%) at least in the second eye and had a statistically significant relationship with entropion (Maini et al. 2019).

Entropion and trichiasis are often diagnosed at the same time. Serious cases should always be treated surgically, as the damage they cause is painful and at worst threatening vision (corneal ulcers, pigmentation; Jalomäki and others 2016).

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Breed	Mean relative palpebral fissure width \pm SE	Mean craniofacial ratio \pm SE	Number of cases (n)	Percent of corneal ulcer cases (%)	Total breed population	Percent of breed affected (%)
Overall population mean	22.1 \pm 0.16	0.51 \pm 0.01				
Pekingese	34.18 \pm 0.53	0.12 \pm 0.01	2	6.5	3	66.7%
Pug	30.06 \pm 0.78	0.08 \pm 0.01	12	38.7	32	37.5%
Shih Tzu	28.53 \pm 0.59	0.20 \pm 0.01	4	12.9	13	30.8%
Bulldog	20.70 \pm 0.53	0.22 \pm 0.15	3	9.7	16	18.8%
Boston Terrier	26.78 \pm 1.13	0.15 \pm 0.01	1	3.2	6	16.7%
Pomeranian	28.77 \pm 0.84	0.43 \pm 0.04	1	3.2	6	16.7%
French Bulldog	23.59 \pm 0.85	0.19 \pm 0.13	2	6.5	13	15.4%
Cavalier King Charles Spaniel	26.99 \pm 0.51	0.40 \pm 0.01	3	9.7	26	11.5%
Staffordshire Bull Terrier	22.90 \pm 0.85	0.51 \pm 0.02	1	3.2	16	6.3%
Labrador Retriever	18.97 \pm 0.31	0.58 \pm 0.01	1	3.2	56	1.8%
Cross Breed	22.38 \pm 0.38	0.54 \pm 0.01	1	3.2	91	1.1%

Prevalences are also shown by breed.

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Fig. 5. Features associated with corneal ulceration in the studied breeds (palpebral fissure = mole place; craniofacial ratio, CFR = relative length of muzzle; corneal ulcer = corneal ulcer). Photo source: Packer et al. 2015b.

7.2.6 Skin

The shortness of the skull is affected by the addition of head and neck deformities, but also the structure of the ear (Salgüero et al. 2016, Mielke et al. 2017, Owen et al. 2004). Short-skulled dogs have a heavier wall of the vibratory and a smaller vibratory than mesocephalic and dolichocephalic dogs (Salgüero et al. 2016, Mielke et al. 2017). The accumulation of water in medium-sized breeds appears to be more common in short-skulled breeds (Salgüero et al. 2016, Mielke et al. 2017, Owen et al. 2004). Narrow ear canals, possibly due to structural abnormality due to short skull, are common findings in clinical patient work and may hamper the treatment and healing of ear infection (Miller et al. 2013, Seppänen et al. 2019). Irreversible changes following chronic ear infection can lead to surgical treatment (Kirsti Schildt, e-mail communication 15.11.2019).

Skin health has been studied, for example, with English bulldogs, which has a number of skin problems (The Bulldog Information Library, Miller et al. 2013, Webb Milum et al. 2018, Mazrier et al. 2016). Seppänen and Others v Commission (2019) in the study, Finnish English bulldogs skin problems were common. The study compared the ear structures of 27 English bulldogs with the structures of 14 mesocephalic dogs and documented dermatological findings of English bulldogs. The owners of the dogs filled out the questionnaire on the skin and ear symptoms of their dog. All English bulldogs had abnormal findings. The omits had not considered the symptoms to be minor. Narrow ear canals were common. The results are in line with the results of a previous study of the same breed that all the dogs examined had findings of your dermatologist and also problems with the paws (Webb Milum et al. 2018).

Middle ear stenosis (Cole 2012) can also lead to hearing problems, the most common cause of which is the poor air circulation between the nasal cavity and the middle ear due to narrowing (Oechtering 2010).

Pododermatitis can be caused, for example, by skin diseases (Miller et al. 2013, White 1989), skeletal and joint diseases (Paterson 2012) or overweight (Kovacs et al. 2005) paw deformity caused by Treatment of paw inflammation due to postural errors is often challenging and there may not be a curative treatment. As the weight is transferred from the sensors to the partially hairy skin, abrasion and weight stress cause the skin to thicken and clogging of the hair follicles. Thickened skin is called false skin. Altered skin is prone to inflammation, fibrosis / connective tissue formation and scarring (Duclos et al. 2008). False feet, on the other hand, predispose to toe furunculosis (Paterson 2012, Duclos et al. 2008).

Dogs with chronic skin problems are often treated with antimicrobials, which contributes to the development of resistant bacteria (Grönthal et al. 2017). The prevalence of MRSP (methicillin - resistant *Staphylococcus pseudintermedius*) was Seppänen et al. (2019) in English bulldogs significantly higher (19%) than other Finnish dog population (3%; Grönthal and Others v Commission of the European Communities 2017 and 2015). However, the study did not establish whether antibiotics were prescribed specifically for skin diseases in the dogs studied.

Chronic skin irritations and inflammations are common especially in short-skulled breeds with skin folds (English Kennel Club 2019). Skin folds are usually found in the muzzle and in corkscrew dogs (DVL2 mutation) also in the tail and in bitches around the vulva. Deep skin folds can abrasion. Inside the folds is moist, which can lead to overgrowth of bacteria and yeasts. These organisms live on the bottom of warp with lefty skin secretions and create a good breeding ground for infections. Organisms also produce substances that irritate the skin. Local infections of skin folds are common if the folds are not cleaned regularly. Infections can be painful, especially if the skin ulcers. Tears and saliva that stick to the folds of the face increase problems, and urine can exacerbate the problems of vulva folds in dogs.

Skin folds may also be so deep that it is difficult to clean them. Seppänen et al. of the European Communities (2019) the deepest tail fold was 4 cm. Most often, the tail warp does not fit on the finger, which is difficult to clean. Often a short-skulled dog is also unable to lick its butt head, which is why the owner does not notice the problem. The dog may rub itself strangely on the floor or furniture. Some dogs can have very painful, chronic, wet, smelly infection. Tail folds can be cored surgically, but this is not an easy procedure. Some of the dogs have a permanently stiff, handle-like structure that may prevent the tail under the eye to treat and causes difficulties (see also section 7.2.3).

The most common skin condition in dogs is atopy / allergy. Atopy can cause chronic itching and make the skin prone to inflammation. Atopy is strongly inherited: Shawn et al. (2004) in the golden and Labrador retrievers, the inheritance rate was 0.47, although the standard error was high (0.17).

Most skin diseases (including allergies) are lifelong (Kirsti Schildt, email communication of 10 November 2019).

7.2.7 Nervous system disorders

Chiari-type malformation and syringomyelia

In a short skull volume of the posterior cavity of the brain may be too small for the amount of brain tissue it contains (so-called Chiari-type malformation, CM). As a result, the cerebellum and often also the brainstem is herniated backwards into or through the neck opening in the skull (foramen magnum). Narrowing of the cranial junction interferes with the circulation of cerebrospinal fluid.

Abnormal cerebrospinal fluid circulation may predispose the cervical cavity to syringomyelia (SM). In syringomyelia, fluid-filled cavities form in the spinal cord as a result of abnormal movement of cerebral fluid. Cavitations are usually generated by the central duct of the spinal cord and, when widened, twist the spinal cord. A short, wide and high skull exposed to syringomyelia, with cramped frontal sinuses and the front twisted upwards. Predisposing factors include narrow cranial cervical spine joints and the loss of the venous flow of the brain. The risk of syringomyelia and symptoms is reduced by the longer shape of the skull (e.g. Knowler 2017).

Chiari-type deformity is thought to be caused by the stress of the development of the skull and brain during individual development. In addition to short skull form, explanation for the emergence of deformity has been sought, including abnormally large cerebellaries and a small posterior pit, as well as abnormal development of the occipital bone (Forsgård 2015, Oechtering 2010). The changes in bones are thought to be the result of premature closure of the cartilage base (Schmidt 2013).

These symptoms are usually caused by damage to the spinal cord or chiari-type malformation caused by syringomyelia (Knowler et al. 2017). Symptoms can sometimes be seen in dogs with Chiari-type malformations but not syringomyelia. This is probably due to compression of trigeminal nucleus located in the cerebelly arthrosous (Pääkkönen 2015).

The first symptoms are usually observed within 6 months to 6 years of age. Dogs with the most severe changes usually start with symptoms under 2 years of age. The progression of symptoms varies: in others symptoms progress slowly or not at all, while others severe pain and neurological deficiency develop rapidly within a few months (Pääkkönen 2015).

Pain is the most common noticeable symptom. The maximum width, length and asymmetry of the fluid cavity of the spinal cord has been found to be strongly associated with the presence of pain, while no such connection has been observed at the degree of cerebellum herniation. In particular, asymmetric lesions of the upper parts of the spinal cord play a key role in the development of nerve damage pain in patients with syringomyelia (Pääkkönen 2015).

Clinical symptoms are mixed: scratching (usually one-sided), spontaneous vocalisation after changing the sudden posture, scoliosis (spine bend laterally) and coordination and weakness of the anterior and/or hind legs. However, it should be noted that most dogs with a magnet scan of syringomyelia are asymptomatic (Parker et al. 2011). Behavioural changes such as fear of foreign people and strange things have also been associated with pain in nerve damage caused by syringomyelia (Pääkkönen 2015).

Based on the symptoms, you cannot make a definite diagnosis, since other diseases can also cause similar symptoms. The diagnosis can only be confirmed by an MRI scan. The treatment at the moment is primarily drug therapy; in addition, surgical treatment is possible.

Syringomyelia is a progressive disease. One study followed symptomatic CM / SM dogs on drug treatment for an average of more than three years. 15% of dogs were euthanised due to severe symptoms, in a quarter of the dogs symptoms remained similar or eased, and the remaining dog's symptoms increased during the follow-up period. However, the majority of owners considered the quality of life of dogs acceptable (Pääkkönen 2015).

Syringomyelia has been specifically studied with Cavalier King Charles Spaniel and Griffons with high prevalence. It is also widely found in king Charles spaniel, Chihuahua and other short-skulled dwarf breeds (Forsgård 2015, Kiviranta et al. 2017; Finnish Kennel Club 2018). The degree of inheritance of Syringomyelia is estimated to be 0.21 (Leiramo 2018) with Finnish Cavalier King Charles Spaniels. Knowler et al. (2011) noted that a breeding programme, based on magnetic resonance imaging (MRI) would reduce syringomyelia in offspring.

The fontanelles

The dog's skull consists of four flat bones that touch each other in the middle of the vertex. The bones of the skull base grow at the cartilage joint between them (allowing the growth of the skull base) and the bones of the upper parts of the skull at the adjacent cranial joints.

The developing brain simultaneously steers the growth of the skull. As the skull develops, there are fontanelles between its bones that allow the brain to grow. Fontanelles are connective tissue membrane structures at the intersection of the cranial bones.

In dogs, the closure of the skull fontanelles is poorly known, but the bregmatic open on the upper side of the head (the opening of the forehead and parietal bones), is estimated to close either before birth or, at the latest, a month of age. In small and short-skulled dog breeds, such as Chihuahua, fontanelles can remain permanently open (e.g. Selby et al. 1979).

A study is under way at the University of Helsinki to determine the frequency and location of fontanelles in Chihuahua as well as correlation to the structural changes commonly found in the breed, such as syringomyelia, large cerebral ventricles, narrow cranial cervical spine

and the symptoms they cause, mainly caused by nerve pain. Based on preliminary results, open fontanelles are found in about 90% of the breed's dogs. In addition to the vertex fontanelles (bregmatic) there are also plenty of open fontanelles on other surfaces covered by a thick bite muscle layer. However, dogs without a vertex fontanelle may have fontanelles on such surfaces of the skull which are nonpalpable (Kiviranta et al. 2020).

The large surface area of the fontanelles is associated with cerebrospinal fluid disorders such as syringomyelia, large cerebral ventricles, narrowing of the cranial cervical spine joint and the symptoms they cause. In addition, the small size of the dogs is linked to the larger area of cranial openings (Kiviranta et al. 2020).

In children, the growth of the skull may be disturbed as a result of the premature expiry of the cranial sutures (so-called craniosynostosis). Children with premature termination of cranial growth are prone to congenital ossification disorders, bone dissolution (re-sorption) and the exclusion of other cranial caries caused by premature expiry (compensating mechanism). The mechanism of formation of open fontanelles in dogs is still open. As dogs experience pre-contingent closure of the cartilage joint of the skull base, it is possible that the mechanisms of changes in dogs are similar to the mechanisms of bone tissue deficiency in the skull in children (Kiviranta et al. 2020).

Preventive measures for fontanelles can only be defined once further information on the issue has been received.

7.2.8 Reproductive performance

Reproduction refers to all related activities, such as mating, gestation, giving birth and care of offspring (Ministry of Agriculture and Forestry 2018). The aim should be for breeding dogs to show normal sexual activity, to be able to mate and give birth normally, to be able to carry until the end of pregnancy and to produce a normal number of puppies free of hereditary diseases (Dahlbom and Lindh 2017). If natural mating is not possible, but the above criteria are met, the veterinarian may, if necessary, undertake artificial insemination.

Difficult whelpings are quite common. It is influenced, for example, by the breed characteristics, the size of the litter, the duration of whelping, as well as various factors related to the dam, the fetus and their joint issues. The Münnich and Kühnmeister study (2009) looked at 530 females with whelping difficulties. The dogs represented a total of 54 different breeds and were aged between 1 and 13 years. Dwarf and small breeds (59.4%) the incidence of whelping difficulties was high. Uterine contraction and spasm, fetal defects and small litter size (only one puppy in the litter that grows too big) were the most common causes of whelping difficulties. Older first-time whelpers (over 6 years of age) had a significantly higher risk of difficulties and dead puppies than young whelpers.

The Gaudet (1985) study involved 182 cases of obstetrics and the age or breed had no effect on the occurrence of whelping difficulties. Medium-size breeds (weight 12.7 to 20.5 kg) were slightly over-represented in the data. 42% of females who had previously given birth had had difficulties. In three of the four incidents, the difficulties were caused by a reason related to the dam (mainly from uterine contraction). Every fourth case the reason was foetal. The most common (48.9%) the cause of whelping difficulties was primary, full uterine contractility. Of these, 40% had small litters of one or two puppies. Of the examined females, 65.7 % had undergone caesarean section.

Short-skulls and snouts are combined with a big and round head, which increases the difficulty of giving birth. In the Boston Terrier study, the larger diameter of the heads of the puppies, the greater the likelihood of whelping problems (Eneroth et al. 1999). The research material included 20 females and a total of 40 litters.

Table 3. Physical obstruction and burn weakness as causes of childbirth difficulties in different races (Evans and Adams 2010).

Physical barrier more general than combustion weakness	Combustion weakness more common than physical barrier	Combustion weakness and physical barrier equally common
King Charles Spaniel Norfolk Terrier Norwich Terrier French Bulldog Yorkshire Terrier	Affenpinscher Beagle Boston Terrier Bullmastiff Clumber Spaniel Irish Wolfhound Labrador Retriever Scottish Deer Hound Scottish Terrier	St. Bernhard Border Collie Bull Terrier Chihuahua Dandie Dinmont Terrier English Bulldog Pekingese

Many short-skulled dogs also have a large chest that makes mating difficult and complicates the delivery of such puppies. It is also characteristic are small pelvis relative to the head and chest, which increases the difficulty of whelping. The heavy structure and the length and shape of the limbs, on the other hand, can affect the ability to mate (Tuire Tamminen, e-mail communication 13.1.2019).

Evans and Adams (2010) survey investigated the prevalence of caesarean sections in various dog breeds. Caesarean sections were very common in many dog breeds, while in some breeds no caesarean surgeries were performed at all. Five out of ten of the most common sectional breeds in the study were short-skulled; in three breeds (Boston terrier, English bulldog, French bulldog) the proportion of caesarean sections accounted for more than 80% of all births. The study also included elective caesarean sections due to the precautionary nature.

In five breeds, whelping difficulties due to physical obstruction were more common than contractile weakness (Table 3); in nine breeds, the contractile weakness was more common. In seven races, the physic barrier was as excessive as contractile weakness (Evans and Adams 2010).

The most caesarean sections were those of Boston terriers, English bulldogs, French bulldogs, Mastiff, Scottish Terrier, dwarf bull terrier, rough-haired German pointer, Clumber spaniel, Pekingese and Dandie Dinmont terrier (Table 4). The likelihood of whelping difficulties increased when the bitch had had difficulty with her previous puppies, when the size of the pup's father was very large compared to the dam, and when the dam's immediate family had had a whelping problems.

On the other hand, for example, a random deformed puppy is not the cause of the difficulty in giving birth to the next whelp (Merja Dahlbom, e-mail communication 5.11.2019). If a male is much larger than a female (e.g. Chihuahua and Great Dane), pregnancy is already a high risk, not to mention whelping.

O'Neill et al. (2017) the study used VetCompass veterinary material. A total of 3.7% of 18,758 non-sterilized bitches had been reported as having whelping difficulties. Short-skulled and dwarf breeds had the greatest number of whelping difficulties. The most common were French bulldogs, Boston terriers, Chihuahuas and Pugs. Dogs aged 3 and over but less than 6 years had just over three times the probability of whelping problems compared to dogs under 3 years of age.

Table 4. The number of caesarean sections reported in the survey and the proportion of all puppies in breeds with a proportion of caesarean sections of at least 35% (Evans and Adams 2010).

Breed	Replies Number of people	Dogs Number of people	Litters Number of people	Caesarean sections	
				No.	%
Alaskan Malamute	10	14	20	7	35
Basset Hound	32	76	116	41	35,3
St. Bernhard	11	32	34	14	41,2
Boston Terrier	14	43	52	48	92,3
Bulldog/English Bulldog	71	195	288	248	86,1
Bullmastiff	29	61	82	29	35,4
Clumber Spaniel	17	44	62	28	45,2
Dandie Dinmont terrier	20	43	70	29	41,4
Greyhound	13	29	37	14	37,8
Brussels Griffon	23	53	82	32	39
Irish Wolfhound	20	58	77	31	40,3
Coarse-haired German Pointer	11	19	23	11	47,8
Pekingese	20	101	178	78	43,8
Dwarf Bull terrier	12	27	42	22	52,4
Mastiff	19	52	79	51	64,6
Neapolitan mastiff	3	7	11	4	36,4
Norwich Terrier	24	78	134	49	36,6
French Bulldog	24	53	80	65	81,3
Sealyham Terrier	6	9	10	4	40
Scottish Terrier	26	99	164	98	59,8
Welsh corgi Pembroke	33	130	199	71	35,7

In Sweden, data of just under 200,000 insured female dogs, the highest risk of whelping difficulties was seen in Chihuahua, Pomeranian, Pug and Staffordshire bull terrier, and in 63.8% of cases, the difficulty led to an emergency section (Bergström et al. 2006). The Scottish terrier had the most whelping difficulties. The study did not involve Boston terrier, English bulldog and French bulldog, as the insurance does not cover caesarean sections of these breeds due to the high frequency.

Small-sized companion and hobby animals, such as dogs or cats, should be inseminated by a person with sufficient knowledge and skill to perform the procedure. The artificial insemination of these animals requires special know-how, and [therefore, in the opinion of the Finnish Food Authority](#), the person making the artificial insemination [must be a veterinarian](#). The problem at the moment is the artificial insemination is carried out by the layman themselves. This phenomenon distorts statistical data on the reproductive capacity of dogs and poses health risks to dogs.

Weak sex drive is a strongly hereditary characteristic. However, the collection of sperm from a weak-libido male may be successful, allowing AI to be possible. A weak-libido bitch is most often aggressive or refuses otherwise to allow mating. The AI of such a female is not only nobly questionable, but also exposes the bitch to physical injuries since it is not possible to sedate the animal while the layman is operating. The use of artificial insemination as a routine means of reproduction can lead to weakened sex drive (Dahlbom and Lindh 2017).

There may also be a structural defect of the genital organs that may hinder mating. In dogs, a strongly generalized problem is the vaginal septum. It's hereditary. It usually prevents mating, because the penis does not fit in and the bitch experiences pain. However, insemination is easy in most cases. In practice, there has been a problem that veterinarians do not always detect the partition (Dahlbom and Lindh 2017). If the female does not allow mating she is usually inseminated artificially. Gestation naturally leads to whelping difficulty, and at the same time the defect may also be inherited by the next generation. The possible female offspring of such a mating should be examined for a vaginal septum before being used for breeding. There may also be buds in the vagina that prevent mating, but the AI is successful. Anatomical abnormalities also require a veterinary assessment of the suitability of the dog for breeding (Dahlbom and Lindh 2017).

7.2.9 Life expectancy

O'Neill et al. (2015) the average life span of extremely short-skulled breeds (English bulldog, French bulldog and Pug) was 8.6 years and the control breeds 12.7 years. According to the Kennel Club's breeding information system (January 2020), between 2010 and 2019, the average life span of the dead and the English bulldogs reported dead was 7 years and 1 month (384 dogs). The corresponding age for French bulldogs was 6 years 3 months (605 dogs) and Pugs 8 years 8 months (310 dogs). When the cause of death was old age instead of illness, behaviour or accident, longer lifetimes were: English bulldogs 9 years 9 months (68 dogs), French bulldog 11 years 2 months (57 dogs) and Pugs 12 years 10 months (61 dogs). O'Neill et al. (2015) used data from veterinary practices, the information from the Kennel Club's breeding information system comes from dog owners.

7.2.10 Summary

[The definition of the Advisory Board on the Welfare of Companion and Recreational Animals for](#) Animal Welfare examines welfare through three rights:

- Right to species-specific behaviour and habitat
- Right to good treatment and positive feelings and experiences
- The right to good health and functional capacity.

Animals are sentient beings who can rightly be claimed to have rights. Rights mean that people have responsibilities towards animals. The rights of animals are, among other things, aimed at safeguarding their welfare: animals therefore have the right to be treated in a way that supports their well-being. People have responsibilities that are similar to this right. Rights can be negative or positive. Negative rights refer to the right not to be disturbed or prevented from others, while positive rights require support and assistance from others. In this context, the use of the word 'justice' obliges animals to work (Advisory Board on the Welfare of Companion and Hobby Animals).

For example, excessive emphasis on certain external aspects of breeding objectives has led to the promotion of extreme features that cause welfare problems for companion and hobby animals. Instead of favouring these extremes, animal breeding should be aimed above all at the production of healthy animals (Ministry of Agriculture and Forestry 2018).

Animals born as a result of breeding should be able to live a life typical of their species in terms of their characteristics. Animals should be able to move, use their senses and endure normal behavioural forms typical of the species concerned. The animal body should function normally and animals should not suffer from long-term illnesses or defects that permanently reduce the quality of life (Agricultural and Forestry Minis 2018).

On the basis of paragraphs 7.2.1 to 7.2.9, it can be concluded that the excessively short shape of the skull and muzzle poses a significant risk to the dog's well-being by even endangering its basic vital functions. Maintaining the shape of such a skull inbreeding may be considered to be contrary to the current Finnish Animal Protection Act: *the use of zootechnical or breeding methods which may cause suffering to an animal or significant harm to the health or good health of the animal is prohibited* (Section 8 of. the Animal Welfare Act).

7.3. Assessment of severity and risks

The most effective and effective reduction of the welfare disadvantages caused by exaggerated brachycephaly is to breed for longer skull and muzzle. If and if only the measurement of diseases and symptoms is raised and no attention is paid to predisposing factors, no significant progress can be made.

The skull structure-focused approach worked to reduce the respiratory problems of the boxers in the 1980s, when German enthusiasts of the breed collaborated with Gerhard Oechtering, an expert in respiratory tract problems. The cooperation led to a significant reduction in the respiratory problems with the slightly longer muzzles not compromising breed type (Oechtering 2011). In breeds where the main mutations affecting the structure of the skull are fixed, this approach also requires cross-breeding with another breed.

In order to allow for processing that promotes the health of short-skulled dogs and meets the requirements of animal welfare legislation, clear methods and tests are needed to measure and predict the severity and risk of harmful characteristics and traits. For most welfare disadvantages, there is already such a method.

7.3.1 Respiratory syndrome

Nikkilä's licentiate study (2017) discusses ways to measure the severity of Brachycephalic Obstructive Airway Syndrome (BOAS) and reduce the incidence of symptoms. The severity of the syndrome can be assessed by clinical signs and observed anatomical changes.

More than half the owners of BOAS dogs do not recognise their dogs' respiratory problems, but consider the symptoms to be normal for short-skulled breeds (Packer et al. 2012, Liu et al. 2015). This undermines the usefulness of the owners' own assessment when selecting breeding dogs.

The severity of the symptoms can be assessed on the basis of the clinical judgement of the veterinarian (Liu et al. 2015, Liu et al. 2016, Lilja-Maula et al. 2017). Liu et al. (2015) use an active classification system in their study where the veterinarian assesses the dog clinically before and after exercise. The clinical evaluation monitors respiratory symptoms such as breathing sounds, difficulty inhaling, mucosal colour and possible mucosal cyanosis as well as syncope are monitored. In addition, the classification will take into account what the owner says and if the dog has previously had cyanosis or fainting. In this case, the dog is classified directly into the severe BOAS category without further testing. There are a total of four severity classes (Liu et al. 2015, Liu et al. 2016):

- Grade 0 - no symptoms; Brachycephalic Obstructive Airway Syndrome.
- Grade I – clinically unaffected but does have mild respiratory signs linked to BOAS. These signs do not affect exercise performance.
- Grade II - moderate BOAS. The dog's symptoms are clinically significant, and the dog requires either surgical or conservative treatment.
- Grade III - severe syndrome. The dog requires surgical treatment as soon as possible.

In addition to the clinical evaluation carried out by the veterinarian, other methods may also be used to determine the severity class. For example, Bernaerts et al. (2010) also used respiratory radiology and endoscope of the pharynx and bronchi.

The risk of developing BOAS increases sharply with a reduction in the relative muzzle length: in the Packer et al. study (2015), Brachycephalic Obstructive Airway Syndrome occurred only in dogs with a muzzle length of less than half the length of their skull. The large circumference of the neck has also been shown to increase the risk of Brachycephalic Obstructive Airway Syndrome (Liu et al. 2017, Packer et al. 2015). The role of this measure was however not as large as the length of the muzzle (Packer et al. 2015). Narrowed nostrils also increase the risk of developing Brachycephalic Obstructive Airway Syndrome; in addition, the degree of narrowing of the nostrils may be related to the severity of the syndrome (Liu et al. 2017).

Mutation of the ADAMTS3 gene causing airway swelling increases the risk of narrowing of the respiratory tract. Of the brachycephalic breeds this mutation occurs in at least English bulldogs, French bulldogs and Staffordshire bull terriers. The mutation can be tested by a gene test to identify the carriers. Dogs with less exaggerated anatomical features and do not carry this mutation have a lower risk of disease.

Assessment of the risk of illness and classification of characteristics/symptoms

Relative size of the muzzle

In the Packer and Others (2015) study, the relative length of the muzzle (craniofacial ratio, CFR) was measured from the head of the chest between the eyes to the inner corners of the eyes. The length of the skull was measured from between the eyes and continuing up between the ears into the back of the skull to the occiput nodule. All measurements were made with soft measuring tape. CFR was calculated by the formula (Figure 6):

Relative muzzle length (CFR) = muzzle length (BC) / skull length (AB)

The minimum CFR value was 0.03. Such a short muzzle was accompanied by a fold of skin over the muzzle, which protrude beyond the muzzle while blocking the nostrils. The mean CFR for dogs with respiratory tract symptoms was 0.15 and in healthy dogs 0.56. 80% of dogs with CFR less than 0.10 were affected by respiratory syndrome. None of the dogs with CFR 0.5 or greater had symptoms. The effect of the relative length of the muzzle was the main risk-increasing structural factor, and other measured structural factors alone did not explain the BOAS symptoms.

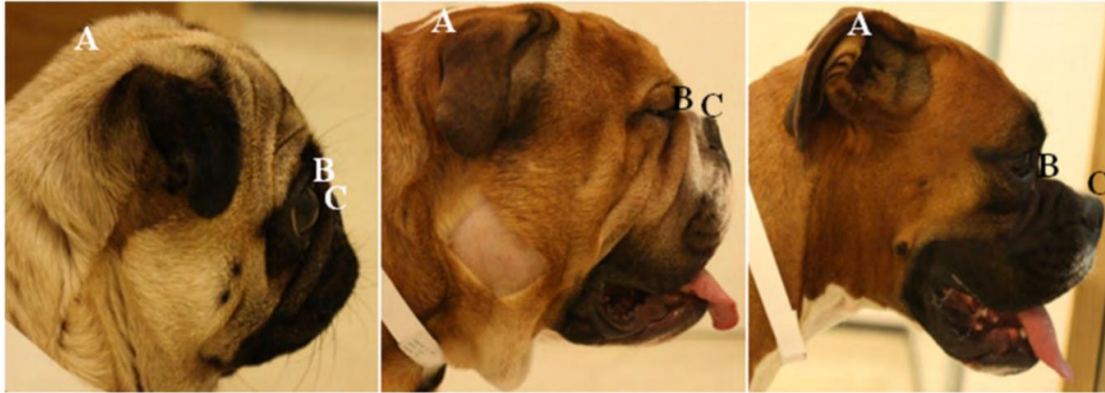


Fig. 6. Measuring the relative length of the muzzle. Cranial length is defined as the distance (mm) from the occipital protuberance (A) to the stop (B). Muzzle length is defined as the distance (mm) from the dorsal tip of the nasal planum (C) to the stop (B). The CFR is obtained by dividing the length of the muzzle by the length of the skull. From left to right visible with a short muzzle (CFR = 0.08), moderately short muzzle (CFR = 0.23) and a slightly short muzzle (CFR = 0.35). CFR = muzzle length divided by the length of the skull. Photo source: Packer et al. 2015.

Packer et al. (2015) proposed adding boundaries to the relative length of the muzzle in the breed standards. If the BOAS risk were to be zero, the relative length of the muzzle should be at least 0.5, which corresponds to the head of the average Staffordshire bull terrier. If the 50% BOAS risk were considered acceptable, the relative length of the muzzle should be more than 0.20. Even then, the risk of developing the syndrome in short-skulled dogs could be significantly reduced.

Council of Europe Resolution 1995:

- A short-skull or muzzle boundaries are prescribed to avoid difficulty in breathing, obstruction of the tear ducts and the vulnerability to childbirth difficulties.

However, measuring the relative length of the muzzle reliably with a tape measure is challenging, especially if the nasal fold is deep. Some dogs are opposed to the measure because it feels uncomfortable. Liu et al. (2017) concluded in their study of Pugs, English bulldogs and French bulldogs that the measurement error is high for measurements with a soft tape measure and that there is a lot of variation between the measures. Therefore, the accuracy and repeatability of the measurement is only moderate.

The relative length of the muzzle could be evaluated and measured from photographs using a computer application. This would eliminate the variation between the measurers and obtain more accurate and verily results.

Nasal stenosis

Liun et al. (2016) the degree of nasal obstruction can be determined as follows:

- Open nostrils (Grade 0; (see Fig. 7). No narrowing.
- Slightly narrowed nostrils (Grade 1). The lateral wall does not apply to the medial or inner wall of the nostril. In addition, after exertion, the nostril wing must move dorsolaterally, i.e. out and upwards during inhalation.

- Moderately narrowed nostrils (Grade 2). The lateral wall hits the meditative wall of the nostril in the dorsal part of the nostril. As a result of this, the nostrils are open only from the lower part of them. In addition, moderately narrowed nostrils cannot open during inhalation after exertion. In this case, around the nose can be seen fluttering as a result of the muscle attempt to expand the nostrils.
- Severely narrowed nostrils (Grade 3). The nostrils are almost completely closed, as a result of which the dog breathes through the mouth even after a slight exercise.



Figure 7. Assessment of nostril stenosis (Liu et al. 2016; Photos: Liisa Lilja-Maula)

The stenosis of the nostrils is relatively easy to visually observe. In addition to the relatively length of the muzzle, the degree of narrowing of the nostrils could be determined, if necessary, by means of a data application from a photo.

Other anatomical features

If necessary, other anatomical features affecting BOAS, such as neck circumference, may also be measured. The Nordic Kennel Union working group mentions the following as measures affecting the syndrome: the nostril stenosis, the length, width and depth of the muzzle, the volume of the pharynx and the firmness of the palate, the length of the neck, the length of the chest as well as the length of the sternum and ribs (Nordic Kennel Union 2017).

Stress tests

Reduced ability to exercise and delayed recovery after exertion are significant factors in BOAS. The severity of the syndrome can be assessed by exertive tests. The tests are non-invasive, which means they do not require anesthesia. They are also easy to implement and repeat, so they can provide a useful method to assess the suitability of individuals for breeding (Lily-Maula et al. 2017, Nikkilä 2017).

Preliminary analysis of problems and means of intervention in the breeding of dogs

Possible stress tests include a six minute walk test (6 MWT) and a 1000 m walk test. The 1000 m walking test determines the maximum time during which the dog must complete the 1000 m walk.

Walking tests are submaximal, i.e. lighter than maximum strain (Lily-Maula et al. 2017, Nikkilä 2017). Dogs walk or trot at their own speed on the leash, driven by the owner or other person, and under veterinary supervision. It should be noted that the test results may be affected, for example, by musculoskeletal problems or the dog's reluctance of movement (Lily-Maula et al. 2017). Dogs to be tested must be adults (at least 1.5-2 years of age) in order to reliably find sick individuals.

Causes of the suspension of the walking test Lilja-Maulan et al. (2017) the study included respiratory distress, such as continuous bodywork and snoring or the use of auxiliary breathing muscles, and an increase in the body temperature of the dog. Dogs with moderate to severe upper respiratory syndrome walked shorter than mildly symptomatic dogs within six minutes. In the same study, the time to a 1000 m walk test was longer in severe cases compared to mild ones.

In Germany, the walking test has been used as a breeding criterion for Pugs since 2009. The test was later taken for English bulldogs and French bulldogs (Nikkilä 2017). The Dutch Kennel Club has used a 1000 m walking test to select English bulldogs suitable for breeding as of 1 June 2014.

The Finnish Kennel Club, together with the University of Helsinki and short-skulled breed [organisations](#), has introduced a 1000 m [walk test](#) to separate good and bad breathers, [which](#) can be used to select dogs for breeding. Instructions for conducting the walk test were published in June 2017. At the same time, the walking test was introduced as an official health examination of the Kennel Club for short-skulled dog breeds in Finland. In this walk test, the dog receives not only the result of the stress test, but also the veterinary assessment of the stenosis of the nostrils and the BOAS symptoms (0 = no symptoms; 1 = mild, 2 = moderate, 3 = serious symptoms; (See Table 5). However, the result of the walking test is not currently affected by the nostril stenosis and the BOAS class.

The time limits for the Finnish walking test have initially been the same for all breeds (up to 12 minutes for walking and 15 minutes for recovery) and have been based on a study conducted with English-bulldogs (Lily-Maula et al. 2017). A normal, healthy canine will require a very limited effort to pass the test. However, even short-skulled breeds are so different that it is necessary to adjust the time limits by breed as the breeds accumulate enough test results. The most appropriate time limit for the Mops and French Bulldogs to distinguish the milder symptoms from the more severely symptomatic is 11 minutes for Aroma and Lilja-Maula (2019), and this limit was taken in these races and in the official test of the Kennelliitto on 1 January 2020.

Based on experience, the walking test in its current form does not always reveal symptomatic dogs. Some symptomatic dogs don't have the trouble to walk at the required distance at a steady pace

within the maximum time frame. In addition to the result of the stress test alone, it would be important to carry out the BOAS classification and nostril stenosis and to issue a recommendation for breeding for all three characteristics. Only a few hundred dogs of different breeds have thus far been tested; as the test levels increase, important information can be obtained on the functioning of the test in different breeds and, if necessary, the test may be developed breed-specifically.

Table 5. BOAS classification based on clinical study (Lilja-Maula et al. 2017, based on Liu et al. 2015).

	BOAS degree ^a			
	THE BOAS		BOAS+	
	0	1b	2b	3
Upper respiratory noise^c at rest	0	0-1	1-2	2-3
0 = not included				
1 = mild				
2 = moderate				
3 = clearly noisy				
Upper respiratory noise^c after exercise	0	1-2	1-2	2-3
0 = not included				
1 = mild				
2 = moderate				
3 = clearly noisy				
Respiratory type at rest	0	0	0-1	1
0 = normal				
1 = use muscles as help ^d				
Shortness of breath or cyanosis at rest	0	0	0	0-1
0 = not detectable				
1 = detectable				

^aDEGREE OF BOAS symptoms: 0 = no symptoms; 1 = mild, 2 = moderate, 3 = serious symptoms.

^bThe dog will receive the following BOAS class as an overall assessment if all symptoms are within the upper limits.

^cBreath sounds without auscultation.

^dThe use of auxiliary muscles is evident: intensified in the movement of nostrils, chest and abdomen.

In spring 2019, The Kennel Club of England introduced a veterinary check for BOAS for mops, English bulldogs and French bulldogs. The inspection is based on the stress test and the listening of the auscultation before and after exertion. The inspection is carried out by a veterinarian who classifies the dog on the same scale as the Finnish walking test. One type of BOAS symptom is the body's heating during exercise. This is typical of English bulldogs, especially based on Finnish data. Unlike the English test, the Finnish walking test also monitors the temperatures of dogs, and the heat rise and the dog's recovery to the initial state in this respect is also one of the test criteria.

A study is underway at the University of Cambridge to develop a genetic test for BOAS. The schedule will be set at a few years. However, BOAS is a complex disease, so it is not possible to develop an unambiguous gene test. Any investigation is therefore a risk assessment.

Pulmonary function test

Nikkilä licentiate study (2017) mentions a full-body plethysmography (WBBP) whole-body barometric plethysmography, which is a lung function test (Liu et al. 2016), which is a lung function test that is very suitable for assessing the severity of the BOAS. WBBP is a non-invasive, easy-to-repeat and objective test that can be performed while the animal is awake. During the pulmonary function test, the dog is in a transparent WBBP chamber. The dog's breathing causes fluctuations in the chamber due to barometric pressure, which can be compared to the dog's single breathing volume. However, the device may restrict its use for purposes other than research.

7.3.2 Musculoskeletal system

The Finnish Kennel Club gives health certificates on vertebral anomaly (VA) and spondylosis (SP) as well as intervertebral disc calcification (IDD). IDD indicates the risk of developing a disc hernia. Certificates are issued by a veterinarian experienced in the diagnosis of skeletal diseases. Vertebrae x-ray can be made if the dog is at least 12 months of age at the time of the x-ray. If the dog is at least 24 months, also other spine changes may be included in the examination certificate. Only certain breeds can receive an IDD certificate; most of these breeds are chondrodystrophic. VA statements are mainly given to corkscrew-tailed breeds and Pugs.

Vertebral malformation scale:

- VA0 – no deformed vertebrae
- VA1 – 1-2 deformed vertebrae
- VA2 – 3-4 deformed vertebrae
- VA3 - 5-9 deformed vertebrae
- VA4 - 10 or more deformed vertebrae.

The spondylosis certificate introduces all the thoracic vertebrae (1-13) and the lumbar vertebrae (1-7) and the sacrum. The scale is as follows:

- SP0, clean - No changes
- SP1, mild - < 3 mm peaks up to 4 intervertebral or > 3 mm peaks up to 3 intervertebral or an islet up to 2 intervertebral intervals.
- SP2, clear spondylosis - Indicates a bridging (full or incomplete) maximum of 2 intervertebral and/or oral islets up to 2 intervertebral intervals.
- SP3, moderate - Bridgings (full or incomplete) and/or large islets 3-7 intervertebral column.
- SP4, severe - More serious changes than in SP0-SP3.

IDD can be detected in the x-rays at the latest at the age of two years. Some calcification may later disappear and therefore the recommended age for X-ray is 24–42 months (Mørck Andersen and Marx 2014). The following step is used in the review:

- IDD0, clean - No changes
- IDD1, mild - 1-2 partially or completely calcified discs

- IDD2 moderate - 3 to 4 partially or completely calcified discs
- IDD3, severe - 5 or more partially or completely calcified discs.

In addition to x-ray of discs, the risk of surgical operation of the disc herbaceous discs can be predicted by genetic testing (chromosome 12 FGF4 retrogen). The relative risk of retrogen interfering in different breeds and in multi-breed dogs varied between Batcher and others. (2019) between 5.5 and 15.1.

In addition to back changes, the severity of the growth disorders (dysplasia) of the hip and elbow joints is also examined by X-rays. The Kennel Club also gives X-ray statements on these defects. The dog can get an certificate at minimum of 12 months of age, in some breeds the minimum age is 18 months. Hip joints use the international dog breeding FCI scale (Paatsama and Brass 1983):

- A - no changes. The head of the femur and the acetabulum are uniform. The cranial edge of the joint is sharp and slightly rounded. The joint gap is tight and even. Norberg scale in the traction position approx. 105° (recommended).
- B - almost normal / border case. The femoral head and acetabulum are slightly inconsistency and Nordberg's angle in a traction position close to 105°, or the center of the femoral head is mediated in relation to the dorsal edge of the acetabulum and the femoral head and acetabulum are uniform.
- C – mild. The head of the femur and the hip bowl are not uniform, Nordberg's scale is about 100° and/or the craniolateral edge of the acetabulum is slightly shallowed. Unevenness or at most mild osteoarthritis changes in the cranial, causal, dorsal, or femoral head or neck of the acetabulum.
- D - moderate (moderate). Obvious unevenness at the end of the femur and acetabulum, subluxation. Norberg's angle is greater than 90° (recommended only). Acetabulum craniolateral edge flattened and/or signs of osteoarthritis.
- E – difficult. Clearly dysplastic hip joint. E.g. high-quality or clear subluxation, Nordberg angle less than 90°, clear flattening of the cranial edge of the acetabulum, deformity of the femoral head (fungal, flattened) or other changes in osteoarthritis.

This scale is followed until the dog reaches the age of 6 years. The review then considering the age of the dog and especially the secondary arthrosis.

The IEWG (International Elbow Working Group) scale is used:

- 0 - No changes
- 1 – mild changes. Mild osteoarthritis (arthrosis) usually first in the upper part of the protrusion (anconeal process) of the elbow (up to 2 mm).
- 2 - moderate changes. The above changes up to 5 mm and/or changes in the radius (coronoid process) and/or mild deformity.
- 3 - severe changes. Stronger degenerative changes/strong deformity. Ununited anconeal process.

The severity of dislocation of the knee joint is clinically investigated using the Putnam scale:

- 0 - The patella does not luxate.
- Stage 1 - The knee joint is almost normal.
- Grade 2 - The kneecap is usually in place with the limb stretched out. The patella luxates when flexing or rotating (when twisting) the knee remains out of the track until it is reinstated. The upper part of the tibia is twisted up to 30 degrees inwards (small dogs).
- Grade 3 - The patella is usually luxated. Patella can be temporarily placed on its place. The upper part of the tibia is rotated up to 30–60 degrees.
- Grade 4 - The patella is permanently dislocated and does not remain in the track without surgery. The upper part of the tibia is twisted up to 90 degrees.

7.3.3 Teeth and mouth

The most serious problems/symptoms of teeth and mouth in short-skulled dogs can be established during a veterinary examination (see Chapter 9.2.4).

The main problems of teeth should be elaborated in further investigation and uniform assessment criteria should be established for them. For the most important teeth, minimum limits should be set for breeding. A similar classification is proposed to the determination of the severity of dental problems as for bone X-rays:

- 0 – normal
- 1 – slight bite/tooth defect(s)
- 2 – moderate bite/tooth defect(s)
- 3 – severe bite/tooth defect(s).

7.3.4 Eye and eye tissues

The so-called official eye checks are carried out in Finland in accordance with the instructions of the European College of Veterinary Ophthalmologists (ECVO). Finnish ophthalmologists are veterinarians recognised by ECVO. In 1998, ECVO drew up a comprehensive eye examination form with guidance, which is currently in use in many European countries.

ECVO rules include conducting eye examination as required regardless of breed and age, as well as recording findings according to instructions. In the case of congenital eye diseases, the dog may obtain the result 'healthy', 'open' or 'confirmed' and, in the case of later manifesting diseases, 'healthy', 'suspicious' or 'diagnosed':

- Healthy: the individual does not show symptoms of hereditary eye disease (vs. observed).
- Open: an individual has been diagnosed with symptoms suggestive of a possible congenital, hereditary eye disease, but the changes are atypical.
- Suspicious: the individual has been diagnosed with minor symptoms of an eye disease typical of the breed, which is later manifested, suspected of being a peasant. The development of symptoms confirms the diagnosis. A recommendation on the date of the re-examination shall be made.

Preliminary analysis of problems and means of intervention in the breeding of dogs

In addition, some characteristics (entropion and ectropion) are also indicated by severity (mild, moderate, severe).

Although extensive eye examination is carried out by a specialized veterinarian the eye symptoms caused by brachycephaly are also available to other veterinarians. In exaggerated short-skull dogs, eye evaluation is also associated with nasal fold assessment (see Chapter 9.2.5).

7.3.5 Skin

Skin problems are difficult to measure and therefore there are no uniform assessment criteria and measurement methods yet. In addition, the effective treatments currently available can mask severe skin problems, which is good for the dogs themselves, but makes it also possible to use affected dogs in breeding.

Seppänen et al. (2019) used the following grading to classify false paw pads (FPP):

- 0 – no FPP
- 1 – mild
- 2 – moderate
- 3 – serious FPP.

The Otitis Index Score, such as the OTIS3 classification (Nuttall and Bensignor 2014), could be used to classify the health of the ears. OTIS3 measures swelling of the ear passages. However, in brachycephalic dogs, the problem is stowage, not swelling, so OTIS3 is not directly applicable for them. In some cases, edema and stenosis are difficult to distinguish (Kirsti Schildt, e-mail communication of 10 November 2019).

Atopic problems can be classified using the Canine Atopic Dermatitis Extent and Severity Index (CADESI)-04 scale. The scale consists of redness, alopecia and thickening of the skin and has been validated in dogs with atopic dermatitis (Olivry et al.

The dog gets a maximum of 180 points on a scale:

- < 10 – normal
- 10-34 – mild
- 35-59 – moderate
- 60-180 - serious.

The (CADESI)-04 scale focuses only on atopia symptoms. Seppänen et al. (2019) also calculated total clinical score (TCS) from the results of skin examinations, which consisted of the dog's CADESI, OTIS and FPP, and whether the dog had furunculosis between the toes or not. These scores did not assess skin folds.

A coherent assessment framework should be established for the assessment of the main skin problems in dogs. Although the criteria do not yet exist, the veterinarian may assess the condition of the paws and tails, as well as the abundance and skin folds of the skin (see Chapter 9.2.6).

7.3.6 Nervous system disorders

Chiari-type malformation and syringomyelia

Syringomyelia can be established by an MRI under the supervision of a specialized veterinarian. The Finnish Kennel Club's neurology working group has prepared a magnetic imaging guide for screening of Chiari-type malformation and syringomyelia. The UK's rating scales have been used.

Syringomyelia degree:

- SM0 - normal, central duct diameter less than 1.0 mm (no central channel expansion ha-cant)
- SM1 - central duct diameter 1.0-1.9 mm
- SM2 - central duct diameter ≥ 2 mm, including syrinx formwork outside the central duct (regardless of the diameter of the central channel) or presyrinx of syrinx.

Chiari malformation:

- CM0 - normal, back of the cerebellum rounded
- CM1 - a depression on the back of the cerebellum, but an obstruction of the cerebral spine visible between the back of the vermis and the foramen magnum of the skull
- CM2 - cerebellum compressed into the neck opening of the skull or herniated through it.

In addition, MRI is assessed for the expanding of the cerebral ventricles as follows:

- VM0 – side ventricle diameter less than cerebral cortex diameter
- VM1 – side ventricle diameter equal to cerebral cortex diameter
- VM2 – side ventricle diameter greater than that of the cerebral cortex.

The dog can be examined at the earliest 18 months of age. Age is taken into account in the assessment and given in the dog's result:

- a - over 5 years of age
- b - 3-5 years old
- c - children under 3 years of age

Knowler et al. (2019) concluded in their pilot study that the risk of syringomyelia can also be visually assessed based on the structure of the skull. The study included Swedish and English dog show judges who judged the dogs based on pictures and scored them according to the instructions. The same dogs also had an MRI scan of the brain. The results were presented with a small number of dogs, and the issue will be further investigated in a larger study. Further studies will hopefully provide concrete information on when the dimensions of the skull are within the risk limits for syringomyelia.

7.3.7 Reproductive capacity

The reproductive capacity of the animal population can be monitored by gathering information of whelpings (normal/caesarean) and litter size. The statistics on mating (normal/artificial insemination) would also provide information on reproductive capacity.

In Europe, there are systems for monitoring caesarean sections of short-skulled dogs, where the litter is assumed to be caesarean cut, unless otherwise stated by the breeder. If the breeder reports normal whelping, the veterinary or kennel counselor must acknowledge the information.

In Finland, the obligation to notify veterinarians of caesarean sections and the reasons for them could be imposed on veterinarians (see Chapter 10.1). The veterinarian could record his caesarean sections in an information system that could also be used for animal welfare control.

7.3.8 DVL2mutation

A commercial genetic test for the DVL2 mutation is possible to achieve, The test would allow the identification of the carriers of the mutation.

7.3.9 Summary

Combating the welfare disadvantages of exaggerated features through numerous health studies carried out on breeding dogs is merely a treatment of symptoms, in place to address and reduce the causes of welfare disadvantages. Lasting results can only be obtained by reducing exaggerated features, which will allow many health studies to be phased out.

8. Definition of criteria for the control of animal welfare legislation

Proposals for the control criteria introduced in chapter 9 have been drawn up in accordance with Finnish animal welfare legislation to cover males and dogs as a species. The criteria therefore apply to all dogs, both pedigreed dogs and multi-breeds. The criteria have been developed especially with regard to the problems of brachycephaly, but there are also criteria suitable for a wider group of dogs, for example in terms of musculoskeletal and extra skin folds.

A transitional period (5 years) is proposed for some of the criteria, such as a five-year budget (see Chapter 8.3). The final criteria would only be introduced after the transitional period, giving breeders time to breed the structure of dogs to a healthier level and also to find individuals who meet the criteria for breeding.

In some dog breeds, the implementation of the Animal Welfare Act has led to a large percentage of the breeding of dogs being eliminated from breeding. In addition, in the light of the current knowledge, in a few breeds, it is not possible to modify the shape of the skull by means of breeding, since the main genetic mutations (BMP3, SMOC2 and DVL2) that shorten the skull are fixed in the breed. In this situation, breeding can be continued by opening the breeds to a genome from which the normal genes forms can be obtained. In practice, this means opening the breed registries for dogs with cross-bred backgrounds, for example.

In determining the control criteria, welfare disadvantages related extreme brachycephaly have been mirrored both in the current Animal Welfare Act and in the proposal for an Animal Welfare Act. For example, in the case of individual harmful mutations, the following issues need to be considered:

1. Can harmful gene form be maintained in a way that does not jeopardise the welfare of animals?
2. If not, what are the chances of the mutation harming its carriers?
 - o is there a risk or does certain combinations of genes always cause this disadvantage?
3. How serious is the harm? Is the severity always the same or does it vary?
4. Can serious harm be prevented?
5. Is it acceptable if only one in 100 individuals suffers significant harm? What about every tenth?

Although these points would be well defined, it is still difficult to draw the line. Perhaps the most fruitful way of considering boundaries is to compare the situation where a similar mutation would now arise. How to deal with it; would it be acceptable to increase the number of animals concerned by breeding?

On the other hand, the same harmful properties may be caused by several different gene combinations and modes of inheritance, and sometimes the exact genetic background is unknown, especially if the inheritance is multigenic. It is more difficult to avoid such characteristics compared to single gene traits and the risk of inheritance should be assessed on the basis of probabilities (see Chapter 8.2). Yet these qualities must also be avoided by the best possible means.

8.1 Assessing the severity of the welfare disadvantage

The current Finnish Animal Welfare Act defines prohibited characteristics as those which cause suffering or significant harm to the animal. The term 'significant harm' is used in the draft Animal Welfare Act. The proposal contains several clear examples and criteria for assessing the severity of the welfare problem (see Chapter 5.3).

In addition to the classification of Asher (2009), Summers (2010) and Collins (2011), this report has also been used for the welfare disadvantage assessment used in the implementation of Swiss animal welfare legislation. Depending on the severity of the welfare disadvantage, the animal may either be used freely for breeding, may be used for breeding under certain conditions or may not be used for breeding. Severity is classified in four categories:

- 0 - no welfare disadvantage; breeding allowed
- 1 - mild welfare disadvantage; breeding allowed
- 2 - moderate welfare disadvantages; breeding allowed, provided that the breeding goal reduces the harm in the offspring compared to parents
- 3 - significant disadvantage; must not be used for breeding.

Hereditary characteristics which may lead to moderate or significant harm are listed in Switzerland in a separate Annex. In accord with Swiss legislation, the owner of the animal shall carry out harm assessment in advance for such characteristics if the animal is designed for breeding (see Chapter 10.3). The animal shall not be used for breeding if:

- a. the harm assessment shows the category 3 harm
- b. the breeding goal leads to progeny being in category 3;
- c. the animals are part of a line of which physiology or characteristics leads to a situation where animal:
 1. cannot be considered in accordance with (species-type) requirements,
 2. cannot maintain a natural position,
 3. cannot move in a species-typical manner,
 4. cannot feed or wean their offspring without human assistance or
 5. it is not possible to exclude:
 - a. sensory loss, especially blindness or deafness, in the offspring or difficult deliveries resulting from anatomical factors.

The proposal for an animal welfare act defines the welfare harm to be significant when the *welfare of an animal suffering from a disease or defect requires, for example, surgical measures or continuous or frequent medication of the animal*. According to the act, such a dog may not be used for breeding if it is not possible to ascertain its own well-being and that the disease or defect is not inherited: *The use of even a phenotypically affected for breeding would not necessarily be prohibited on the basis of the provision if it can be ensured that it does not inherit the disease or defect to its offspring. Of course, the use of such an animal for breeding would require consideration as to whether the other requirements of animal protection legislation are met and whether the breeding use is detrimental to the welfare of the animal as specified in paragraph 2(3).*

8.2. Research requirements for breeding dogs

The Dutch legislation on animal husbandry states that administrative provisions may govern for example:

- requirements for animals, semen, ova and embryos, including registration in the herd-book
- on tests, inspections and tests carried out on animals;
- assessment of the performance of the animals and the value of the genome
- requirements for the commencement of breeding of the animal. (Aarbacke 2012)

The Swiss Animal Welfare Act has defined at the level of the Regulation that animals suspected of having a moderate or significant welfare disadvantage must be examined prior to breeding. The procedure is defined in the Food Safety and Veterinary Office (FSVO) Regulation on the protection of animals in breeding. Using population genetics and statistics, it may be defined that a moderate or significant welfare disadvantage may be suspected if such harm occurs in the breeding line (breed) or in certain types of animals in general. The draft of the Finnish welfare also mentions the examination of animals before breeding.

The draft Animal Welfare Act is consistent that welfare damage can be considered likely if the *use of a breeding combination on the basis of existing data entails a higher than average risk of inheriting diseases or other characteristics referred to in the article*. Diseases specific to certain breeds and dog types are more likely in these breeds and types than the average in all dogs.

A risk assessment relating to a particular type of dog or breed may be carried out on the basis of breed characteristics, and the risk assessment in an individual dog is based on the dog's own phenotype and health test results, as well as on similar data from its' relatives, including previous offspring.

Information on individual dogs is available, for example, from the breeding database of the Finnish Kennel Club. The system also includes breed-specific statistics on health tests and causes of death as well as breeding programmes (indicative programmes and/or PEVISAt), which can also be applied to the breeding of multi-breed dogs of the same type. Information on the prevalence of genetic variants of different breeds and dog types that cause genetic diseases can be retrieved from, for example, the [MyBreedData - Canine Inherited Disorder Prevalence Database](#). The [VetCompass veterinary data](#) of the British Royal Veterinary College and breed profiles by the pet insurance company Agria contain information on the prevalence of polygenetic problems and causes of death.

Knowledge of the underlying causes and genetics of hereditary problems in dogs is increasing and therefore requires constant updating of health research requirements for brachycephalic breeds and other control criteria. The need for updating is also the case when breed situations change: when the health status of the breed improves, the test requirements of breeding dogs can be loosened. Monitoring the situation in breeding programmes is therefore absolutely essential. In order to ensure that each

Situation can be handled as needed, an impartial, consultative expert body or panel to make recommendations on each situation is needed to improve the effectiveness of the Animal Welfare Act. Such a panel is operational in some European countries (see Chapter 10.3).

8.3 Transitional period

Some of the control criteria set out in Chapter 9 are staggered in the same way as in the Netherlands (van Hagen 2019). During the transitional period, dogs with a moderate welfare disadvantage could also be used for breeding for some control criteria if the following conditions are met:

- a healthy partner for this criterion is used.
- mating, gestation, delivery and care of the puppies cause no additional adverse effect on the well-being of the dog.

After the transition period, the criteria would be tightened so that the limit value would be mild welfare harm, and such a dog should, as a rule, be combined with a healthy dog. In the 4 and 5 scale hereditary diseases presented in 7.3.1 to 7.3.5, the moderate welfare disadvantage or its' risk usually corresponds to that of the second worst grade: e.g. in hip dysplasia it would be the letter D (scale A-E) and in elbow dysplasia grade 2 (scale 0-3).

9. Proposals for control criteria for dog breeding

Interpreting our animal welfare legislation, the breeding dog must not have serious malformations associated with the short-skull structure, which are predisposing to significant welfare handicaps, nor serious illnesses and symptoms of respiratory and thermoregulation systems or digestive system, nor in teeth, eyes, skin, nervous system or other organs. If the dog has a mild defect/disease, it could be used for breeding if the other side of the combination does not have the same defect/disease (excluding possible transitional period). Breeding dogs must also be able to reproduce normally. Section 9.2 covers the following: criteria that meet these terms. Some of the proposed criteria relate only to exaggerated brachycephaly, others may also be used in other types of dogs.

9.1. Assessment of the dog and the combination with regard to welfare-related properties

The breeder must be able to prove that the animals used in his breeding meet the requirements of the animal welfare legislation (see Chapter 4.1). This means that animals' health traits must be tested with appropriate pre-mating studies/measurements if they belong to a breed or breeding line or if their characteristics reflect a breed or breeding line where a characteristic/disease causing a moderate or significant welfare disadvantage is common. Such breeds/breeding lines/dog types should be defined in the further survey. The appropriate test/measurement uses a method found to be appropriate in veterinary medicine, and the health certificate for progressive diseases and defects is also sufficiently recent.

The health certificate shall show that the animal has been identified at the time of the examination and that the veterinarian has ensured by means of an identification mark that the certificate is issued to the correct individual. In the absence of a uniform assessment criterion for the defect/disease, the risk contained in the breeding group shall be assessed on the basis of the characteristics of the animals' own and close relatives.

9.2. Breeding restrictions

The breeding restrictions proposed below have been developed in cooperation with specialist veterinarians and authorities. The restrictions do not apply to diseases, symptoms and features caused by trauma.

9.2.1 General restrictions

It is not allowed to use for breeding

- a dog who has **undergone surgical intervention to correct a structural defect or weakness and/or to relieve symptoms** (for a more detailed definition of defects and weaknesses later, see section 4.2. Table 2)

- a dog who needs continuous or repeated medication due to a **disease or defect considered hereditary**
- dogs with a **relative muzzle (CFR) of less than 0,33**. During the transitional period (e.g. 5 years), the breeding use of such a dog would be permitted if the dog had been examined before mating as follows:
 - o Exercise testing carried out to assess respiratory and thermoregulatory capacity and the grades of BOAS and nostril stenosis. The testing should be done under the supervision of a veterinarian experienced in dog exercise testing. The dog should be at least 18 months of age at the time of the test. In dogs under 3 years of age the test is valid for 24 months.
 - o Veterinary certificate on the status of the eyes, teeth and skin (especially the folds, paws, ears and tail settling; See. Annex 1). The certificate may be issued in the context of a basic health check or exercise testing.
 - o The CFR limit shall be stricter, if necessary, after a transitional period.
 - o For CFR, it is recommended to set the goal to be at least 0,5.

9.2.2. Respiratory and thermoregulation control

It is not allowed to use for breeding

- dogs with or **clearly noticeable signs of respiratory syndrome**, e.g.
 - o and abnormal upper respiratory span when awake in the rest (rhonkus, snuffle, snoring, coughing, wheezing of the nose, throat or larynx),
 - o cyanosis or fainting
 - o chronic gastrointestinal symptoms associated with breathing difficulties
 - o other clear signs of breathing difficulties
- a dog who has received a **failed stress test result**
- a dog with **severe BOAS symptoms** assessed in the stress test (BOAS class 3)
 - o the criterion tightens after the transition period, in which case dogs with moderate to severe BOAS symptoms (BOAS class 2 or 3) may not be used for breeding.
 - o however, the following combinations of BOAS classes are allowed during the transitional period: 0+0, 0+1, 0+2, 1+1 (two dogs with mild symptoms, BOAS 1).
 - the criterion of combinations will be tightened, if necessary after the transitional period,
- dogs with **almost completely closed nostrils** (Grade 3) and therefore has to breathe by mouth
 - the criterion tightens after the transition period, in which case dogs with a nostril stowage degree of 2 or 3 may not be used for breeding.
 - however, the following combinations of nostrils are permitted during the transitional period: 0+0, 0+1, 0+2, 1+1, 1+2. In addition, 2+2 if the BOAS class of both dogs in the combination is 0.

Other

It is recommended that the use of photographs, e.g. a computer/mobile application, be recommended to assess the nostril stenosis and the relative length of the muzzle. The images would be

With the dog's identifications. Before the application is introduced, measurements can be carried out with a measuring tape (relative length of the muzzle) and visually rated (stenosis of the nostrils).

Assessment of respiratory problems:

The breed-specific guidelines of the Nordic Kennel Club (Nordic Kennel Club 2018) reflect clear breathing difficulties as follows: *Clear difficulties are suggested if the dog is already standing still and without a clear external reason (heat, stimuli, etc.) is a matter of difficulty, for example:*

- *Breathes through the mouth with corners of the mouth clearly withdrawn and/or tongue clearly out*
- *Pronounced breathing sounds (snoring); and/or exhalation sound is clearly heard*
- *A clear withdrawal is visible in the front and/or behind the chest during breathing*
- *The head and neck nod to the pace of breathing.*

It should be noted that the last two points describe breathing difficulties requiring intermediate veterinary assistance.

The assessment of breathing should always include the observation of possible symptoms during and after the evaluation of the dog's movements.

Signs of general exhaustion, as well as prolonged and severe recovery after movement, are very serious symptoms and signs of severely reduced respiratory capacity (Nordic Kennel Union 2018; see also Swedish kennel club [video for respiratorytiinevaluations](#)).

9.2.3 Musculoskeletal system

According to current knowledge, a particular risk to moderate or severe welfare damage is associated with vertebrae malformations is associated with homozygous DVL2 mutation -> the need for health examination (x-ray) before mating.

It is not allowed to use for breeding

- dogs with or have a **history of severe pain and/or difficulty moving caused by conformation** (see section 4.4). [Identification of dog pain](#)
- dogs with or which have a history of other significant **musculoskeletal symptoms considered hereditary**
- dog whose tail **twists tightly around the anus or inwards, making it difficult to defecate** (see also section 9.2.6 Skin)
- dog whose **health certificate/veterinary opinion indicates a severe disease/defect** (see Chapter 7.3.2)
 - o a dog with moderately severe defect/disease should only be mated with a dog that is normal (healthy) or borderline in relation to the defect/disease in question.

- o dogs with moderate to severe severity after the transitional period shall not be used for breeding;
- o after the transitional period, only combinations with maximum of one of the parents have a mild defect/disease are recommended for breeding.

In the 4- and 5-grade defects presented in section 7.3.2, moderate grade corresponds to the second most severe degree of the scale (e.g. in the case of a hip dysplasia, the letter D, and in the case of an elbow dysplasia the grade 2). Mild grade corresponds with the previous degree.

9.2.4 Teeth and mouth

There is a lack of a coherent assessment criteria for teething and mouth, which is why it needs further analysis.

It is not allowed to use for breeding

- dogs with or which have a history of significant **symptoms due to teeth**, e.g.
 - o clearly noticeable pains/eating difficulties
 - o a tooth position error in which the teeth have abnormal contact with soft wet tissues or other teeth; e.g. teeth that damage the gums, the canine tooth going into palate
- dogs with a clearly visible problem of tooth fitting in because of a short jaw: **teeth twisted and/or displaced**
- a dog with **jaws not closing normally**
- dogs with **paralyzed tongue**
- a dog whose **lower lip wraps between the teeth and interferes with the bite**
- dogs with **other significant teeth symptoms considered hereditary**.

9.2.5 Eye and eye tissues

It is not allowed to use for breeding

- a dog with a history or presence of **significant eye symptoms of irritation, dry eye and/or pain**, e.g.
 - o **extra lashes or eyelid rotation that cause corneal abrasion**.
- dogs with a fold of **skin that touches or covers the eyes**
- a dog with a **visible fold of skin covering the rhinarium** (nasal fold)
- dogs whose **nasal fold hair touches the connective or cornea of the eye** (hairs of the fold moist), or has signs of inflammation in the **nasal fold**
- a dog that **cannot completely close its eyes**
- dogs whose **eyelid reflexes do not work**

- a dog with **visible** sclera in two or more quarters of the eye when looking straight ahead
- a dog whose **eyeball has previously come out of its pit**
- who is **blind**
- a male who is blind for hereditary reasons (for reasons other than hereditary, a veterinary opinion/treatment report must be available)
- a dog with a history of **hereditary eye disease** causing significant **welfare-inducing adverse** effects
 - o if the severity of the eye disease is defined (e.g. skin folds and eyelid rotation; see also section 9.2.6), dogs with a severe degree of disease/defect should not be used for breeding
 - a dog with moderate degree of the defect/disease may only be combined with a dog that is healthy in relation to the defect/disease
 - after the transitional period, dogs with moderate to severe degree of the defect/disease shall not be used for breeding
 - after the transitional period, a dog with a mild degree defect/disease may only be connected to a dog that is normal/healthy in relation to the defect/disease.

9.2.6 Skin

There is a lack of a coherent assessment criteria for skin problems, which is why it needs further analysis.

It is not allowed to use for breeding

- dogs who have or have had **significant skin symptoms**, e.g.
 - o recurrent or chronic skin infections, e.g. ear infections, furunculosis, pododermatitis
 - o inflammation requiring treatment in skin folds in dogs, e.g. tail fold, nasal fold, fold around the anus/vulva, lip folds
- dogs with **too much skin or skin folds that can cause eye, ear or skin problems**; e.g.
 - o skin that covers the eyes
 - o deep skin folds that do not ventilate
- a dog whose **tail is pressed at the base of the tail** in such a way as to create difficult stenosis and/or problems with defecation

9.2.7 Nervous system disorders

It is not allowed to use for breeding

- dogs with a **history of paralysis or intervertebral disc hernia**
- a dog that is **congenitally deaf in both ears**
- dogs have or have had **clearly noticeable symptoms of syringomyelia**, such as pain; for instance

- o scratching (usually one-sided), even if the foot does not touch the scratching area at all.
- o head rubbing
- o spontaneous noise after sudden change of position
- o scoliosis (lateral spine)
- o coordination problems and weakness of the fore and/or hind limbs
- o unwillingness or inability to move
- o increased sensitivity to touch, especially in the head, neck, shoulders and chest area
- **combination of dogs for which breeding is not recommended according to the BVA syringomyelia guidelines** (see section 4.4). Table 6)
 - o the appropriate syringomyelia health examination is based on MRI scans at least 18 months of age administered by a veterinary surgeon specializing in neurology. The certificate obtained under the age of 3 is valid for 24 months.
- **dogs with other significant neurological symptoms considered hereditary**

Since syringomyelia is a disease associated with the structure of the skull, it is most effective by breeding the structure of the skull in a more normal direction. Knowler's et al. (2019) research team is developing a visual assessment method to replace MRI in the future.

Table 6. Breeding instructions to avoid syringomyelia in young age (Cappello and Rusbridge 2007 and the British Veterinary Association and The English Kennel Club).

Finnish Championships	Age (years)	Connect to the dog, the result of which is:
0a (normal)	more than 5	Anything except 2c (SM)
0b (normal)	3-5	SM 0a, 0b, 0c, 1a
0c (normal)	1-3	SM 0a, 0b, 1a
1a (CCD)	more than 5	Anything you want.
1b (CCD)	3-5	SM 0a, 1a
1c (CCD)	1-3	Sm 0a, 1a
2a (SM)	more than 5	SM 0a, 1a
2b (SM)	3-5	SM 0a, 1a
2c (SM)	1-3	Not for breeding
SM/CM clinical signs	Anything you want.	Not for breeding

SM = syringomyelia, CM = Chiari malformation, CCD = ventricle dilation

9.2.8 Reproductive performance

ESL (247/1996) § 8 Zootechnics and genetic engineering

Animal breeding shall take into account animal welfare considerations and animal health. Animal breeding or the use of breeding methods which may compromise animal health or cause significant harm to the health or welfare of the animal shall be prohibited.

He36/1995 Detailed justification Article 8(2) adds: *In addition, it is intended to prevent the increase in difficult deliveries and the emergence of permanent malformations in the offspring caused by inappropriate breeding.*

Processing restrictions

Reproduction refers to all related activities, such as mating, gestation, delivery and the care of offspring (Ministry of Agriculture and Forestry 2018).

The dog must not be used for breeding if:

- it has a **defect, disease or trait that prevents natural reproduction**, e.g.
 - o body structure, which makes it unable to mate naturally or give birth to offspring without caesarean section
 - o vaginal septum, which would require surgical intervention to remove.
 - Based on current knowledge, a delicate partition that the veterinarian can cut off with his fingers or that would break during normal mating, does not constitute a hinderance to mating or delivery;
 - if the dam has had a septum, the female offspring should be examined before breeding.
- **would be likely to cause significant harm to its well-being**, e.g.
 - o in the case of a disease which causes significant harm to well-being, a genetically affected dog if severe stress may cause a clinical illness
 - o combination is one in which, for example, the large size of the offspring or extreme structural characteristics prevent natural delivery
 - o the female is not fit enough for mating, gestation or delivery
 - o mating is done by forcing
- **The female has gone through two cesarean sections.**

In above cases, the use of artificial insemination to allow the breeding of animals would also be prohibited (Ministry of Agriculture and Forestry 2018). Methods of artificial breeding shall not be used to replace the natural reproductive behaviour of the animal. Furthermore, mating must not take place by coercion.

The person making artificial insemination of dogs should be a veterinarian. The veterinarian may also instruct the breeder and refuse to inseminate the on animal welfare grounds.

The potential for embryo transfers and genetic modifications must also take into account animal welfare issues and animal health (ESL (247/1996) Section 8 Animal breeding and genetic engineering).

9.2.9 DVL2 mutation

The current Finnish Animal Welfare Act instruct the following to prevent the use of animal breeding in relation to malformations and difficult deliveries: *the idea is to prevent breeding which produces animals whose appearance or genome causes suffering or significant harm to the animal and to prevent the proliferation of difficult deliveries and the emergence of permanent malformations in the offspring caused by inappropriate animal breeding (HE36/1995 8. 2).*

The proposed new animal welfare law instructs: *animals with harmful exaggerated features should not be used for breeding unless, for example, with genetic testing or otherwise can be ensured that the harm is not transmitted to offspring or if it is, for example, by means of breed crosses, to improve the characteristics of the offspring in this respect. In this case, however, it must always be ensured that reproduction does not harm the animal itself because of these extremes.*

In addition, the proposal gives examples of the genetic factors referred to in the regulation: *lethal alleles or alleles related to certain diseases or other welfare disadvantages, such as anatomical extremism or structural weaknesses. As an example, an exaggerated short muzzle and therefore structurally narrow airway, which can cause constant breathing difficulties for the animal.*

The DVL2 mutation differs from many other known mutations in that it does not in itself cause diseases but malformations due to developmental disorders, which in turn predispose to defects and welfare problems. In the light of current knowledge, mutation can be considered to be a risk gene for moderate or significant welfare disadvantages caused by skeletal deformity. These welfare risks are also affected by minor genes that affect the appearance of the dog and the severity of the welfare handicap within the limits of the actual mutation. In this respect, the welfare disadvantages of the mutation are polygenetic.

The outcome of polygenetic inheritance is difficult to predict in advance. Due to recombination, plays a role when alleles of minor effect transmit from parents to form the genomes of the offspring. However, even dogs with mild deformities which do not cause harm to the individual itself may, transmit serious malformations on their offspring and thus also significant well-being disadvantage. It is essential to assess the significance of the mutation whether it is possible to prevent the associated health damage, in other words whether it is possible to maintain the mutation without moderate or significant welfare disadvantages. If, in addition to homozygous DVL2 mutation, the dog carries other alleles affecting to the same direction, such as the SMOC2 and BMP3 mutations that shorten the skull, the brachycephaly becomes more extreme and, consequently, the likelihood of significant well-being disadvantages increases.

In assessing the DVL2 mutation, it is also essential to consider whether the deliberately causing large-scale development disorders to animals through breeding is ethical and in line with our legislation on animal welfare, even if some dogs have only have mild welfare problems.

The report of the University of Helsinki's Genetic Research Group discusses (2018) the situation of English bulldog, French bulldog and Boston terrier in relation to the high DVL2 mutation frequency: The frequency of the mutation means that it is not possible to get rid of it by breeding within the breeds. Only breed crosses can bring relief to the situation of these dogs and breeds. The elimination of the mutation eliminates the "bulldoggy" features of the breeds. It should be seriously considered whether the maintenance of breeds with developmental disorders can be considered ethically sustainable – or even in accordance with the current Animal Welfare Act (Section 8(2) of 247/1996).

According to the view of the Finnish Veterinary Association (2019), the breeding of purebred English and French bulldogs and Boston terriers carrying DVL2 developmental disorder genes must be interpreted as contrary to the Animal Welfare Act in the light of current knowledge.

Declaration by the Council of Europe (EN 1995) on the conclusion that the breeding of animals of the following types is avoided or stopped, unless it is possible to eliminate serious harm:

- animals carrying a recessive, harmful gene (e.g. homozygous Scottish fold cats - short limbs, spinal and tail defects)

[The](#) mutation causing the appearance of the Scottish fold cat is comparable to the DVL2 mutation in that both cause developmental disturbance/ disturbances with significant well-known adverse effects. According to current knowledge, the Scottish fold is caused by an incomplete dominant mutation, where all cats receiving the mutation either from their sires or their dams, have deformities and early-developing osteoarthritis, causing significant pain. The more precise study on the association between the DVL2 mutation and developmental disorders is still under way (Lohi and Hytönen, oral communication 4.9.2019).

Proposed way forward

The criteria for the DVL2 mutation under animal welfare legislation will be confirmed when studies on a more precise role of the mutation are completed. The additional information available is unlikely to resolve the risks currently known, so that at this stage it is recommended not to combine two carriers. At least one parent is therefore recommended to be homozygous for normal alleles. Bulldog-like traits can be applied to breeds from other cranial mutations that pose health risks that are more limited than the DVL2 mutation, according to current knowledge.

9.3 Familiarization of veterinarians induction further criteria

If necessary, the status of the dog may be specified and ensured by a specialist veterinarian.

Both control veterinarians and specialist veterinarians in each field should be familiarized with the use of the scales used in the animal welfare control in order to ensure that interpretations are as coherent as possible.

10 Proposed measures

10.1 Veterinary reports of hereditary defects and central register

In order to effectively monitor the control criteria set out in this report, all dogs should be entered in the statutory identification and ownership register. In addition, the control veterinarian should be informed of artificial inseminations, caesarean sections, surgical operations and other treatments performed on dogs to relieve the symptoms of extreme or hereditary diseases.

The Finnish Veterinary Association has raised the need to enact for the responsibility of the veterinarian to report hereditary defects and illnesses that have required the treatment of the breeding animal or which compromises its' quality of life, without prejudice to any obligation of professional secrecy. Access to information by the veterinarian needs to be improved in cases where the breeding of animals is contrary to legislation (Lahti 2017). The same need was identified in several opinions given on the proposal of the new law. The Finnish Veterinary Practitioners is also in favour of the notification obligation (Finnish Veterinary Association and Finnish Veterinary Practitioners 2018).

Veterinarians should be subject to the obligation to notify and thus the right to notify the following operations/treatments:

- birth problems and caesarean sections including their causes, e.g. vaginal septum
- surgical operations to correct a structural defect or weakness and/or to relieve symptoms
- other diseases that impair the well-being of the dog, which require treatment, such as chronic ear infections and pododermatitis.

The notifications would be stored in the information system mentioned in Chapter 7.3.7, which could be used in animal welfare. This system could be linked to the planned dog identification and owner register.

10.2 Health checks and prohibition of display

One example of possible measures is health inspections of puppies in short-skulled dogs. The Swedish veterinarians have requested veterinary checks and detailed veterinary examination for puppies in connection with their sale and insurance. Also the Finnish Veterinary Association and the Finnish Veterinary Practitioners (2018) have proposed a puppy health certificate for the breeding of short-skulled dogs. The certificate would be developed in cooperation with breed organisations and veterinarians and would be a certain assurance to the purchaser that the parents of the litter meet the breeding criteria. The health certificate could be issued during litter inspections when the breeder presents the required health test results to the veterinarian.

In addition to health checks, measures could also apply to dog competitions. The Resolution of the European Council (1995) states that *banning the breeding of certain types of breeds or species and the gradual stop of exhibiting and sale is being considered when the characteristics of the animals concerned correspond, for example, to the harmful features set out in the Annex.*

In the preparation of the Animal Welfare Act, the Finnish Veterinary Association suggested that all existing breeds of dogs are viable or whether some should be banned. In May 2019, the Finnish Veterinarians' Association called for a total ban on the breeding of three short-skulled breeds.

However, the banning of breeds does not solve welfare problems, as dogs with exaggerated structures could then be grown as multi-breed and crossbreeds. Animal welfare legislation applies equally to both pedigreed dogs and mixed breeds. If, instead of banning breeds, limits are set for exaggerated characteristics, the harmfulness of such features will also be prevented in multi-breed dogs and in breeds for which extremism is still developing.

Austrian animal welfare legislation prohibits the exhibition of dogs with the following characteristics or symptoms: shortness of breath, movement disorders, paralysis, dermatitis, inflammation of the eye conjunctiva or cornea, blindness, deafness, neurological symptoms, tooth malformations and cranial malformations. The implementation of the ban is monitored by the official veterinarian. The dog may be closed from the exhibition if it is found to have aforementioned characteristics or symptoms. (Section 5 of the Austrian Animal Welfare Act).

In addition to the breeding *ban*, Switzerland has been banned exhibiting animals which have been bred with prohibited breeding goals: Animals bred with prohibited breeding goals may not be exhibited (from 1 March 2018; Section 30a§4b TSchV).

In Sweden, a dog who receives a quality rating of 'abandoned' in the exhibition for health reasons can be excluded from all exhibitions, tests, competitions and breeding. The new rule came force in 1.1.2020. It aims to prevent the use of sick individuals in breeding. The dog may have been abandoned in the exhibition ring because of morbid features since 1998, but now the Swedish Kennel Club is tightening sanctions. If the reason for the rejection is respiratory problems, the dog is immediately closed for all forms of testing and competition. The dog owner may request a change of decision if the dog passes a separately designated veterinary examination and does not show any difficulty breathing. In other health problems, the dog owner receives a warning after two rejected grades that the third rejected means permanent closure (Our Dog 2019).

In their opinion (2018), the Finnish Veterinary Association and the Finnish Veterinary Practitioners proposed to require a walking test not only for breeding dogs, but also for all extremely short-nosed dogs participating in exhibitions. If there were no accepted result, participation in the exhibition would be refused. A ban on some of the most severely affected breeds to participate in competitions and in the competition category of dog shows with dogs who would not pass the control criteria proposed in Chapter 9.1 could be an effective breeding control measure.

The prohibition could relate specifically to competition, that is to say, an activity in which dogs are placed in a better order.

10.3 Breeding Ethics Board

Chapter 8.2 highlighted the need for an impartial consultative expert body/panel. In some countries, such as Switzerland, the processing criteria and controls are carried out by special panels responsible for assessing the harmfulness of processing in the case of major genetic diseases or defects. In Switzerland, the members of the Boards have been elected to represent different interested parties and actors. In Finland, board could, for example:

- Assess the importance of different welfare disadvantages and the risk of inheritance
- Present animal welfare legislation control criteria and other necessary measures
- Approve any deviation from the control criteria on the basis of the application (cf. Swiss adverse assessment)
- Monitor of the health status of breeding lines and populations
- Update control criteria
- Place an animal welfare-based breeding programme on individual breeding lines (e.g. breeds) where necessary.

There are also special advisory boards in Denmark and the Netherlands to assist the authorities in difficult animal welfare issues (Aarbacke 2012). In Australia, the Victoria state uses a procedure where breeding programmes where sick offspring, taking into account the genetic heritage of parents, are likely to be born, must take careful account of the consequences and ethics of the combinations. Only organisations approved by the Ministry and suitable for approving such breeding programmes. The Ministry and its approved breeding organisations maintain a list of hereditary problems regarding which this procedure is applied. The breeder must be a member of the breeding organisation in order to be able to take part in the breeding programme. If these diseases can cause serious well-being problems for the offspring, breeding programmes must be very well justified. The resulting offspring should be examined by a veterinarian and should be euthanized in case they suffer. Such animals shall not be used for breeding. The code of conduct takes into account the mode of inheritance of the disease/defect and provides detailed breeding instructions (Victoria State Government).

Swiss animal welfare legislation lists the specific characteristics which may lead to a moderate or significant welfare disadvantage. Where the Swiss breeding combination involves a significant welfare disadvantage, the animal shall not be used for breeding at all or the combination carried out. If there is a risk to a moderate welfare disadvantage, the owner/breeder shall document the combination and, for such characteristics, prepare a foreground assessment if the animal is planned to be used for breeding. An adverse assessment may be carried out by a person with a university degree in veterinary medicine, ethology or genetics/animal breeding, or with sufficient knowledge of the matter in question. The person planning the breeding shall, at the request, present the document to the supervising authority. The document must reveal a breeding plan and possible hereditary defects and diseases of parents and offspring.

The breeding plan shall indicate how the breeding combination is thought to have a minor hereditary welfare disadvantage in the offspring compared to parents. The document must be updated and kept up to date. The owner must sign that the information is accurate and complete. The purchaser of the animal shall be given written instructions on the care of the animal to reduce the suffering or stress it is suffering or stress.

10.4 Follow-up report

This preliminary study focused on the hereditary characteristics of significant welfare handicaps that require the most urgent implementation of the Animal Welfare Act. A large part of the control criteria set out in the report are defined only for the problems of short-skulled dogs. For example, skin and eye diseases will also require examination of the whole dog population. Some of the welfare disadvantages mentioned in the report have not yet set out the monitoring criteria, while some of the monitoring criteria proposed require even more detailed definition.

The breeding ban in the event of a dog being operated to correct its defect or weakness and/or to relief symptoms should be further defined and a list of defects and weaknesses set out for monitoring. Similarly, examples of eye diseases excluded from breeding and, where possible, breeds/breeding lines/dog types, for which health examinations should be carried out prior to mating, for example in the case of musculoskeletal system, eyes and syringomyelia, should be determined.

A number of hereditary diseases and predisposing characteristics, including psychological extremism, are completely excluded from the survey. These features should be considered in a possible follow-up study. The further study should also explain in more detail the association between certain genes and mutations with significant welfare problems, such as the published association between the chromosome 12 FGF4 retrogen to the intervertebral disc hernia (Batcher et al. 2019).

For homozygous DVL2 mutation, the final control criteria can only be established when studies on a more accurate effect of mutation are completed.

Inbreeding should also be considered and, if necessary, the minimum age for breeding animals and the maximum number of litters/offspring. Moderate and information-based breeding reduces the risk of hereditary diseases in the offspring.

10.5 Legislative development and enforcement guidelines

It is essential that legislation on animal protection be developed in order to address the prohibited breeding activities in practice. The new Animal Welfare Act also requires more detailed legislation than the actual legal text (regulation), on which law enforcement supervision can be based, as well as guidance on supervision. The position should be adjusted more precisely

for example, the hereditary defects which are subject to the envisaged obligation of veterinarians to notify. Similarly, faults should be made for defects that clearly exclude the animal from breeding.

It is proposed to introduce the control criteria in line with this report already during the current animal welfare legislation.

When introducing the criteria, consideration should also be given to the means of intervention in the import of animals for which processing does not meet the requirements of Finnish animal protection legislation. One step in this direction would be to increase the reporting obligations of people who sell dogs. The seller should state to the buyer all the significant welfare problems identified in the report (see section 9.2) and their importance for the well-being of dogs. In order to monitor the obligations of sellers, information on the origin of the dog (breeder, seller) should be stored in the identification register of dogs.

11 Glossary

- Allele – A variety of gene options for a specific gene locus, which can be multiple, but only two specimens of the kul-cap (one in each counterpart chromosome). The alleles of the individual are either identical (homozygot) or different (heterozygotia).
- Dermatological – Skin-related
- Dominant – Dominant, dominant (gene, allele), which is manifested as simple; receding gene form, preventing this view from being
- Eriperinous, heterozygous – a cell or organism with different counterparts; the individual has two different forms of gene
- Generation F1 – First Generation of Intersect
- Phenotypic, phenotypic material – Individual phenotype; observable properties based on genotype and environmental interaction;
- Fixed allele – when there is only one allele option left in the locus (cf. loss of genes from the population)
- Frequency — Relative share; E.g. allele frequency refers to the all alleles in the gene in question.
- Gene form – Gene version or variant or allele
- Genome – Individual genome; individual's genetic factors consisting of inheritances inherited from the mother and the father; general language usually refers to the whole of the individual's genes
- Genotype – The whole of the individual's genes in a specific locus or attribute
- Heterozygous, differently perinted - The individual has two different forms of gene (alleles)
- Histological – Tissue associated; tissue-related
- Homozygous, similarly retraction - The individual has two identical forms (alleles)
- Confederaltrophic – Short limb
- Chronic – Prolonged or recurrent
- Lethal factor – During the gestation period or shortly after birth, death leading to
- Lokus – Alleel's location in a chromosome
- Multigenous inheritance – The determination of the property is influenced by a large number of genes and environmental factors
- Morphological – Form and structure
- Mutation, gene mutation, gene change – structural mutagenicity in one or more genes that, if occurring in a gameme, can be inherited from the progeny;
- Neuropathic – neurological, neurological
- Degree of inheritance – The proportion of additive inter-individual variability in total variability, i.e. the relative share of hereditary differences in the variability measured in the characteristics. Describes the refine ability of a property in a specific animal population
- Population — A group of species members in a region where they can reproduce with their secondary lives; e.g. a group of animals or a breed to which the specimens belong

- Bottleneck phenomenon – A significant contraction in population size, after which the size of population increases again, but genetic variability has decreased and the probability of pedigree increased
- Recombination - Reorganization of the alleles. The groupage of alleles in various locuses at random reproducing germ cell as a result of the fusion and fertilization of germ cells. Recombination is the reason for the emergence of new combinations of characteristics in the offspring compared to parents.
- Recessive - Recessed, opaque; appears only when appearing in two paragraphs (parallel)
- Same-quality homozygous - The individual has two genetic forms (alleles)
- Semilethal factor – Resilient
- Breeding – Reproduction of relatives among themselves. The combination of cousins or more closely related persons shall be considered to be
- Breeding degree - A measure of the intensity of the breeding; indicates the likelihood of an individual gene pair allele from the same ancestor
- Trauma - Injury, damage; 1. tissue damage caused by external force; 2. Mental injury caused by strong heat
- Monogenic inheritance – The characteristic is determined by a single gene

The criteria presented may also be applied to other similar diseases, symptoms or characteristics. The criteria do not apply to diseases, symptoms and traits caused by trauma.

	For more information, see section 6.1 a report paragraph/chapter	Prohibition of processing during the transitional period (e.g. 5 years)	Prohibition of processing after transitional period	Other considerations
Public				
Surgical intervention to correct a structural defect or weakness and/or to address symptoms (further definition at a later date)	Chapter 6, Table 2 and Chapter 8.1	X	X	
Need for continuous or repeated medication due to a hereditary illness or defect		X	X	
Relative muzzle length (CFR)	Chapter 7.3.1	No prohibition, but if less than 0.33, be before mating veterinary opinion on the points marked with an asterisk ()	<0.33	
*BREATHING AND TEMPERATURE REGULATION	Chapters 7.2.1 and 7.3.1			
Clear signs of respiratory syndrome, e.g. clearly intimated, abnormal upper respiratory control at rest		X	X	
Other clear signs of respiratory problems (e.g. bluntisation, syncope, chronic gastrointestinal symptoms)		X	X	
*Dogs at risk: before mating, the father and mother of the litter have been tested or corresponding stress test		Rejected	Rejected	Minimum age of testing 18 months. Under 3 years of age the test has been carried out for 24 months.
*Dog's own BOAS class		3	2-3	
*Combination BOAS classes		See Figure 1	Tighten if necessary	
Fig. 1. Allowed combinations in green and prohibited in striped red.				
*Nasal obstruction		3	2-3	
*Combination nasal obstruction		See Figure 2	Tighten if necessary	
Fig. 2. Allowed combinations in green and prohibited in striped red. Orange (2+2) is allowed if both combination the BOAS class for dogs is 0.				
MUSCULOSKELETAL SYSTEM	Figures 7.2.3 and 7.3.2			
Obvious structural pain and/or difficulty moving		X	X	
Other significant bone or joint symptoms considered hereditary	Chapter 6, Table 2 and Chapter 8.1	X	X	
Tightly around the anus or twisting inward, defecation makes him difficult		X	X	
Dogs at risk: pre-mating examination/measurement of the litter's father and dam		See Figure 3 (left)	See Figure 3 (right)	
Fig. 3. Permitted combinations in green, prohibited in striped red. Orange (mild+mild) is not recommended. Left transitional crite and the right criteria after the transitional period.				
*TEETH AND MOUTH	Figures 7.2.4 and 7.3.3			
Noticeable pains/eating difficulties		X	X	

The criteria presented may also be applied to other similar diseases, symptoms or characteristics. The criteria do not apply to diseases, symptoms and traits caused by trauma.

	For more information, see section 6.1 Inventory paragraph/chapter	Prohibition of processing during the transitional period (e.g. 5 years)	Prohibition of processing after transitional period	Other considerations
*Dental position error with abnormal contact with soft tissues or other teeth the teeth; E.g. teeth that damage the gums, the canines that press into the palate		X	X	
*Noticeable tooth ing problem with short jaw, teeth twisted and/or displaced		X	X	
*Jaws do not close normally, strong jaw mismatch		X	X	
Flaccid, paralyzed language		X	X	
A twisted lower lip between the teeth that interferes with the bite		X	X	
Other significant hereditary symptoms due to teething	Chapter 6, Table 2 and Chapter 8.1	X	X	
*EYES AND EYE TISSUES	Chapters 7.2.5 and 7.3.4			
*Significant eye symptoms of irritation, dry eye and/or pain, e.g. additional lashes or mole casts causing corneal abrasion.		X	X	
*Eye-appropriate or eye-covering skin fold		X	X	
*Nose warp covering the flea		X	X	
*Eyelid closure		Incomplete	Incomplete	
*Mole reflexes		Incomplete	Incomplete	
*Whites of the eyes visible when the dog looks straight ahead		In two or more quarters,	Away from the outer side of the eye and more than Minimally	
The eyeball has come out of its hole in the past.		X	X	
Blindness with a		X	X	
Hereditary blindness with yrok		X	X	For non-hereditary reasons, the may be accompanied by a veterinary opinion or management report
A known hereditary eye disease that causes significant well-being, e.g. PRA or lensluxation	Chapter 6, Table 2 and Chapter 8.1	X	X	
Dogs at risk: pre-mating, examination/measurement of the litter's father and dam, E.g. mole touring		See Figure 4 (left)	See Figure 4 (right)	
Figure 4. Allowed combinations in green and prohibited in striped red.		<div><div><div>Isä</div><div>Normaali</div><div>Lievä</div><div>Kohtal.</div><div>Vakava</div></div><div><div>Isä</div><div>Normaali</div><div>Lievä</div><div>Kohtal.</div><div>Vakava</div></div></div> <div><div><div>Isä</div><div>Normaali</div><div>Lievä</div><div>Kohtal.</div><div>Vakava</div></div><div><div>Isä</div><div>Normaali</div><div>Lievä</div><div>Kohtal.</div><div>Vakava</div></div></div>		
*SKIN	Chapters 7.2.6 and 7.3.5			
*Regularly recurrent or chronic skin infections, e.g. ear infections, furunculosis, pododermatitis		X	X	
*Noticeable rash on folds requiring treatment (e.g. tail, nose, lips, anus, vulva)		X	X	
*Too rich skin or skin folds that can cause eye, ear or skin problems; e.g. deep skin folds that do not ventilate or the skin that covers the eyes		X	X	
*He is pressed at the base of the tail, causing difficult to treat stenosis and/or problems defecation		X	X	
Nervous system	Chapters 7.2.7 and 7.3.6			
A dog has been diagnosed with paralysis/herd		X	X	
Congenital deafness (neither ear can hear)		X	X	

The criteria presented may also be applied to other similar diseases, symptoms or characteristics. The criteria do not apply to diseases, symptoms and traits caused by trauma.

	For more information, see section 6.1 a report paragraph/chapter	Prohibition of processing during the transitional period (e.g. 5 years)	Prohibition of processing after transitional period	Other considerations																																	
Clearly noticeable symptoms of syringomyelia	Chapter 9.2.7	X	X																																		
Dogs at risk: pre-mating, examination/measurement of the litter's father and dam, syringomyelia		See. Figure 5	See. Figure 5	Minimum age of study 18 months. The statement obtained under the age of 3 is valid for 24 months.																																	
Fig. 5. Processing instructions and restrictions to avoid syringomyelia		<table><thead><tr><th>SM-aste</th><th>Ikä (vuosina)</th><th>Yhdistä koiraan, jonka tulos on</th></tr></thead><tbody><tr><td>0a (normaali)</td><td>yli 5</td><td>Mikä vain paitsi 2c (SM)</td></tr><tr><td>0b (normaali)</td><td>3-5</td><td>SM 0a, 0b, 0c, 1a</td></tr><tr><td>0c (normaali)</td><td>1-3</td><td>SM 0a, 0b, 1a</td></tr><tr><td>1a (CCD)</td><td>yli 5</td><td>Mikä vain</td></tr><tr><td>1b (CCD)</td><td>3-5</td><td>SM 0a, 1a</td></tr><tr><td>1c (CCD)</td><td>1-3</td><td>SM 0a, 1a</td></tr><tr><td>2a (SM)</td><td>yli 5</td><td>SM 0a, 1a</td></tr><tr><td>2b (SM)</td><td>3-5</td><td>SM 0a, 1a</td></tr><tr><td>2c (SM)</td><td>1-3</td><td>Ei jalostukseen</td></tr><tr><td>SM/CM kliinisiä oireita</td><td>Mikä vain</td><td>Ei jalostukseen</td></tr></tbody></table>		SM-aste	Ikä (vuosina)	Yhdistä koiraan, jonka tulos on	0a (normaali)	yli 5	Mikä vain paitsi 2c (SM)	0b (normaali)	3-5	SM 0a, 0b, 0c, 1a	0c (normaali)	1-3	SM 0a, 0b, 1a	1a (CCD)	yli 5	Mikä vain	1b (CCD)	3-5	SM 0a, 1a	1c (CCD)	1-3	SM 0a, 1a	2a (SM)	yli 5	SM 0a, 1a	2b (SM)	3-5	SM 0a, 1a	2c (SM)	1-3	Ei jalostukseen	SM/CM kliinisiä oireita	Mikä vain	Ei jalostukseen	
SM-aste	Ikä (vuosina)	Yhdistä koiraan, jonka tulos on																																			
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0b (normaali)	3-5	SM 0a, 0b, 0c, 1a																																			
0c (normaali)	1-3	SM 0a, 0b, 1a																																			
1a (CCD)	yli 5	Mikä vain																																			
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2a (SM)	yli 5	SM 0a, 1a																																			
2b (SM)	3-5	SM 0a, 1a																																			
2c (SM)	1-3	Ei jalostukseen																																			
SM/CM kliinisiä oireita	Mikä vain	Ei jalostukseen																																			
Other significant nervous system symptoms considered hereditary	Chapter 6, Table 2 and Chapter 8.1	X	X																																		
REPRODUCTION AND REPRODUCTIVE CAPACITY																																					
Chapters 7.2.8 and 7.3.7																																					
Defect, disease or property that prevents natural reproduction; e.g. self-employed/offspring physique or vaginal septum, the removal of which would require surgical intervention		x (including artificial insemination prohibited)	x (including artificial insemination prohibited)																																		
Defect, disease or characteristic aggravated by reproduction or an onset of clinical signs may cause		x (including artificial insemination prohibited)	x (including artificial insemination prohibited)																																		
not fit enough for apentü		X	X																																		
Forced mating		X	X																																		
Caesarean section, number		If a previously two	If a previously two																																		
GENETIC DEFECTS																																					
Chapter 6, Table 2 and Chapter 8, 8.1																																					
DVL2	Chapters 7.1, 7.2.3, 9.2.3 and 9.2.9	It is recommended that at least the other is a homozygous for normal body (does not carry mutation). The final control criteria shall be established when: studies on the more accurate effect of mutation will be completed.	To be confirmed when studies on a more accurate will be completed.																																		

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