Rocz. Nauk. Zoot., Vol. 48, No 1: 15–28

NEGATIVE HEALTH CHANGES IN BRACHYCEPHALIC DOGS RESULTING FROM BREEDING PRESSURE – A REVIEW

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Abstract

The authors present some health problems of brachycephalic canine breeds in the hope that especially dog breeders will pay more attention to the quality of life of their pets. Brachycephalic dogs are characterized by a specific anatomical structure of the head with a square-shaped skull and a shortened and flattened muzzle. Such anatomy is associated with the occurrence of specific health problems, the most common of which are: brachycephalic airway syndrome (BAS), neurological abnormalities due to pressure on the spinal cord, visual problems, malocclusion, allergies and skin disorders, problems with heart performance, reproductive problems and other. The most common disease of brachycephalic dog breeds is BAS, a syndrome caused by anatomical defects that most often affects French bulldogs, English bulldogs, Shih Tzu, pugs, Boston terriers and Pekingese. The breeding herd should consist of dogs that are free from any clinical signs of BAS and have anatomic features that reduce the risk of health complications. This requires close cooperation between dog owners, breeders,

veterinarians and kennel judges. Knowing about the health problems specific to certain breeds can support dog owners, breeders and veterinarians in improving the health and, most importantly, the welfare of these dogs. The goal of the modern dog breeding is that all dogs are functionally healthy, have a breed-specific build and behavior, and live a long, healthy and happy life.
Keywords: BAS, welfare, dog breeding, health problems, brachycephalic dogs.

Introduction

The dog is one of the oldest domesticated animals. In the past, the main reason for keeping dogs was the utility; dogs were used for hunting, guarding grazing animals or guarding homesteads. Over time, people have learned to use other skills of the quadruped, the breading began with selection for traits that were considered useful. Today, most dogs are seen as companions, which has led to prioritization of the conformation (King et al. 2012), making the dog the species of the greatest racial diversity. New desirable traits, which have been created using appropriate selection and genetics, are perpetuated by the next generations. Over last century, we observe a multitude of new breeds registrations, which are created only because of their more and more sophisticated, far different appearance from the original breed.

The effect of such practice is, for example, dog breeds in the brachycephalic type. Changes in the body structure often entail many health problems, which often result from thoughtless crossings under the influence of current fashion. Unfortunately, many times reckless pseudo-breeders, aware of the rising demand for more and more bizarre-looking dogs, have started a mass production of puppies, ignoring the outcomes to their health condition. In a study on domestic animals, the German veterinary pathologist Achim Gruber (2020) called such dogs "elegant cripples," and it seems that the term very aptly applies to brachycephalic breeds in particular. Health is also largely determined by the genetic structure of the population, described, inter alia, by the level of affinity and inbreeding. These features should be carefully monitored in order to avoid the reduction of the genetic pool and the possibility of inbreeding depression (Leroy 2011, Kania-Gierdziewicz et al. 2014).

Veterinarians in many countries, including Poland, sound the alarm, claiming that the quality of life of certain breeds of dogs has deteriorated significantly. Unfortunately, many breeders of purebred dogs believe that the appearance of the dog and satisfying the requirements of dog shows is much more important than its health, comfort of life, and character. The fact that the

dog suffers is widely accepted by breeders in the name of meeting show requirements. It is the kennel judges who determine the breed trends when assessing the dogs at shows and they have a great influence on the selection of stud dogs for breeding. Thus, they indirectly contribute to deterioration of the health and welfare of purebred dogs (Fawcett et al. 2019). Indrebø (2008) found that a judge may contribute to health problems in purebred dogs by putting pressure on breeders to select breeding dogs of particular appearance. This is the so-called "Over-typing" in a given breed. The author stated that judges must recognize their responsibility for the health problems of purebred dogs and adequately educate breeders to implement appropriate breeding programs to improve animal welfare. Therefore, cooperation between veterinarians and Kennel Clubs is necessary in order to educate the judges to understand the functional anatomy and various health problems of purebred dogs. Fawcet et al. (2019) even believe that veterinarians have a professional and moral obligation to prevent any negative effects that are caused by an altered conformation of brachycephalic dogs that could degrade their welfare.

According to Adams et al. (2010), the life expectancy of purebred dogs has significantly decreased over the past decades. Inoue et al. (2018) found that the average life expectancy of mongrels is 15.1 years, and that of purebred dogs is much shorter, 13.6 years. Urfer et al. (2020) found that dogs of breeds with larger populations, and therefore with greater genetic diversity and lower inbreeding, live longer than dogs of breeds with smaller population sizes and higher inbreeding rates. This indicates that genetic diversity can affect the lifespan of dogs of certain breeds. Kania-Gierdziewicz et al. (2011) analyzed a population of German Shepherds in terms of relatedness and inbreeding. The mean level of inbreeding was estimated at 13%, while the mean relatedness was around 4%. The conclusion was that such a high level of inbreeding may have a negative impact on health, and therefore the population requires monitoring of genetic variability. It has also been found that within popular breeds with large numbers of individuals, adverse changes occur more slowly and are mainly related to the uneven use of stud dogs; some stud dogs are used for mating much more often than others (which is known as the "popular stud" effect). These findings should be the subject of reflection on a more thoughtful search for sires in a given breed, so that their possible ralatedness with brood bitches from the same populations is as low as possible. Within dog breeds with a small population size, there is a rapid and adverse change in the genetic structure of the population and effects of excessive homozygosity in the form of genetic defects appear (Kania-Gierdziewicz et al. 2014).

In this study, the authors decided to present some health problems of breeds of the brachycephalic type in the hope that especially dog breeders will pay more attention to the quality of life of their pets.

Health problems of dogs of brachycephalic breeds

The most glaring example of intensive breeding procedures and related health problems are, as already mentioned, dogs of the brachycephalic type. Brachycephalic dogs are characterized by a specific anatomical structure of the head with a square skull and a shortened and flattened muzzle. This body structure is associated with certain abnormalities, which was the basis for the term BAS (brachycephalic airway syndrome), which reflects the anatomical defects. The breeds predisposed to BAS are mostly French bulldogs, English bulldogs, Shih Tzu, pugs, Boston terriers, Pekingese and other brachycephalic breeds. The syndrome has also been reported in other breeds, where, over the years of breeding, a tendency to shorten the muzzle compared to the breed prototypes was observed. Such observations were made, for example, in Bernese mountain dogs or Norwegian terriers (Koch et al. 2012). Within the typically brachycephalic breeds, there is still a tendency to shorten the muzzle through selection, creating individuals with caricaturally bulging heads (Koch and Sturzenegger, 2015). Packer and Tivers (2015) found that the shorter the muzzle, the more severe the BAS problem. However, in an analysis by Ravn-Mølby et al. (2019) there was no significant relationship between muzzle length and the incidence of BAS in French bulldogs.

Most brachycephalic dogs are beautiful animals, full of unquestioned charm, due to the unusual structure of the visceral skull. This is why they are so popular among the owners of quadrupeds. Dog lovers decide to purchase a puppy of such a breed because of its characteristic appearance, but also due to low requirements of the breed in terms of physical activity. However, not everyone realizes that the beauty of the dog comes at a cost of medical problems, which will entail enormous amounts of veterinary care in the future. In recent years, there has been much debate in the UK over the breeding of such dogs, and the British Veterinary Association, along with the Royal Veterinary College and the Kennel Club, appealed to potential owners to think deeply about their purchase due to the possible burden of multiple health issues. It is impossible not to notice that representatives of this group of dogs have problems with breathing, they wheeze and snore, which is related to, among others: stenotic nares, elongated soft palate, narrowed trachea, and an overgrown tongue which panting – the dog's natural body-cooling activity – very difficult. The list of health problems in individuals of this type is long, the most common ones including:

- BAS, i.e. the syndrome of anatomical defects leading to hypoxia,
- neurological abnormalities related to pressure on the spinal cord,

- vision problems,
- malocclusion,
- allergies and skin problems,
- poor heart performance,
- reproductive problems etc.

Research by Steinert et al. (2019), on the attitudes of people towards brachycephalic breeds, proved that despite their knowledge of animal welfare, the popularity of these breeds does not seem to decrease. The deformities that occur are commonly accepted and considered by breeders to be "normal", since they meet the breed standards. The ailments are usually ignored or remain unnoticed, and only the most severe cases are reported to veterinarians. |Owners treat problems like breathing conditions as "breed-related specificity" (Packer et al. 2012). Packer et al. (2019) found that the most frequently reported disorders by owners of brachycephalic dog owners were allergies, corneal ulcers, skin fold infections, and BAS. Some veterinarians even call for the cessation of reproduction of some of the brachycephalic breeds. The New Zealand veterinarians, who are aware that the health and welfare of English bulldogs, pugs and French bulldogs has deteriorated too much, appeal for discontinuation of their breeding (Farrow et al. 2014).

O'Neill et al. (2019) performed an analysis of health problems in English bulldogs. They found that the most common diseases were skin disorders, occurring in over 28% of dogs of this breed. This was followed by vision disorders (in 18% of dogs), hearing disorders (in 13% of dogs), eneropathy (in more than 11% of dogs), and disorders of the upper respiratory tract (in more than 10% of dogs). According to the analysis of these authors, the most common diseases of English bulldogs were external otitis, pyoderma and obesity. In the studies of Pedersen et al. (2016) an analysis of the genetic diversity of the English bulldog breed from the USA, Finland, Canada, Austria, Hungary and other countries was conducted. The dogs have been found to have very low genetic diversity, which makes it almost impossible to eliminate from breeding the genotypic and phenotypic abnormalities leading to poor health. Greater genetic diversity would eliminate harmful recessive mutations and improve the anatomy of these dogs, which would positively affect the health. The breed's breathing problems are the result of complex changes in the structure of the head and cannot be corrected simply by lengthening the muzzle.

The breeding pressure resulted in extreme brachycephaly, chondrodysplasia, skin folding, and other phenotypic features which are characteristic to brachycephalic breeds (Quilez et al.

2011). The selection has often aggravated health problems, which has affected the wellfare (Pegram et al. 2020). An example of this is the English bulldog, which several decades ago had a much less massive conformation (Leighton 1924). As a result of the conducted breeding, their body mass increased significantly, and their muzzle was shortened and raised even more, leading to respiratory diseases. Also, increasing skin folds, especially around the mouth, have led to skin diseases and eye problems (Pedersen et al. 2016).

BAS and problems with thermoregulation

The airway syndrome of brachycephalic breeds is very dangerous to the health of dogs, because it shortens the breath, and consequently leads to hypoxia and cardiological problems. Unfortunately, many brachycephalic dog owners believe that some of morbid symptoms (loud wheezing, snoring, cyanosis, frequent fainting, and even vomiting, and other symptoms that aggravate especially after intensive exercise or at high ambient temperatures) are simply a characteristic of the breed and do not allow themselves to think that an intervention of a veterinarian is needed. This state of affairs is also reported by Packer et al. (2019), who – based on surveys among brachycephalic dog owners – found that they refuse to accept that their dogs might require veterinary assistance, despite the fact that they are aware of their dog's health issues. The authors claim that as many as 70.9% of owners believe their dog is in very good or best possible condition, and only 6.8% of owners believe that their dog is less healthy than the breed average. This is a wrong approach, because with corrective treatments you can help your dog and increase its comfort of life. Dupré and Heidenreich (2016), citing other authors, state that in 90% of dogs that underwent nostril and soft palate corrective surgery, the comfort of life improved. Unfortunately, these authors also stated that in almost 100% of cases the health problems recur. However, the ailments rucurring after surgery are not as acute as before. Fasanelli et al. (2010) also found that 12% of dogs that underwent corrective surgery had postoperative complications.

In order to find out what problems we are dealing with, we should carefully examine the dog's throat and larynx (Fasanella et al. 2010, Meola 2013, Emmerson 2014), because this disease is related to several components and these are mainly:

• hypertrophy of the anterior nostrils (the nasal wings are too large in relation to the nasal passage and block its lumen),

• hypertrophy of the soft palate (due to the shortening of the nostrils in relation to the skull and frequent swelling of the tissues of the soft palate that obstruct the access to the trachea),

• eversion of the laryngeal pockets (increased pressure in the trachea causes swelling and adherence of the laryngeal pockets to the lumen of the trachea)

• the so-called inversion (rotation) of the tonsils (Fasanella et al. 2010).

As a result of these anatomical changes, air turbulence and airway resistance are increased, which may cause the development of secondary changes that may cause life-threatening respiratory diseases (Meola 2013, Caccamo et al. 2014, Sainio et al. 2020). In such dogs, the so-called inspiratory breathlessness, which may progress to respiratory failure, soft tissue swelling, obstruction of the upper respiratory tract, which may be fatal. In addition to respiratory failure, these changes can also lead to cardiovascular failure. This is because the increased airway resistance leads to an increase in pressure in the lungs (pulmonary hypertension) and this in turn leads to right-sided remodeling of the heart (so-called pulmonary heart), which can lead to right congestive heart failure (Canola et al. 2018).

Sainio et al. (2020) found that the prevalence of brachycephalic breeds respiratory syndrome ranges from 10% to as much as 50% in this type of dog. According to Fasanella et al. (2010), the English bulldogs (out of 90 dogs of this breed, 55 were found to have this disease, i.e. 61%), pugs (BAS was found in 21% of dogs of this breed) and Boston terriers (in 9% of dogs) are the most exposed to the respiratory syndrome of brachycephalic dogs. Dupré and Heidenreich (2016) also found that English bulldogs, pugs and Boston terriers were most often affected by BAS, but also other brachcephalic breeds such as: French bulldogs, Pekingese, Shih Tzu, Cavalier King Charles spaniels, Boxers, Dogue de Bordeaux and bullmastiffs. Fasanella et al. (2010) report that the most common components of BAS were an elongated soft palate, which occurred in 94% of dogs with this condition, followed by stenotic nares, which occurred in 77% of dogs with this condition, and eversion of the laryngeal pockets occurred in 66% and the curled tonsils in 56% of BAS-affected dogs. Dogs most often had 3 or 4 BAS components, with the most common combinations being stenotic nares, elongated soft palate, everted laryngeal pockets, and curved tonsils. Dogs with stenotic nares were significantly more likely to develop laryngeal pockets, and dogs with evolved laryngeal pockets were significantly more likely to develop curved adenoids.

According to a report prepared by the Scientific Committee of the FCI (Sainio et al. 2020), in order to reduce the number and even eliminate the problems of the occurrence of the respiratory syndrome of brachycephalic breeds, it is first of all to exclude dogs suffering from BAS and operated on for this reason from breeding. In individual countries, there should be an

easily accessible and comparable monitoring of the health of dogs, by recording all cases of disease, this should also include the offspring of dogs with BAS. You should also choose dogs with less exaggerated anatomical features for breeding, e.g. without stenotic nares, without heavy skin folds on the nose, or not choose dogs that have an excessively short and thick neck and are obese.

Dogs are characterized by a specific thermoregulatory mechanism, panting, i.e. exhaling air together with excess water, like in humans through sweating. This is facilitated by the lateral nasal gland (glandula nasalis lateralis), which, by secreting fluid into the nasal vestibule, enhances evaporation, facilitating the process of rapid heat exchange (Packer and Tivers 2015). The function of these glands is similar to that of the sweat glands in humans. Due to the altered structure of the muzzle in brachycephalic dogs, especially the nose, these breeds have an impaired panting cooling, which significantly increases their risk of heat stroke (Packer and Tivers 2015). According to the authors, in dogs without brachycephaly, a properly built nose and lateral nasal gland are responsible for about 19 to 36% of effective thermoregulation processes, which is why dogs with brachycephaly have it difficult, especially in periods with increased ambient temperature (Davis et al. 2017). This manifests as a significant increase in respiratory rate, which can lead to respiratory failure. Thermoregulation problems worsen even more in overweight dogs; Davis et al. (2017) report that weight gain was positively correlated with the frequency and intensity of heat stress. Among the brachycephalic dogs, accoding to German et al. (2017), English bulldogs are one of the most likely to become overweight. Davis et al. (2017), comparing how brachycephalic dogs and dogs without brachycephaly cope with heat stress, found that dogs with brachycephaly had reduced thermoregulatory capacity compared to thouse without brachycephaly. Also Packer et al. (2019) found that as many as 39.5% of brachycephalic dog owners say that their dogs have problems with proper thermoregulation. Gruber (2020) found that short-skulled dogs must make four times more effort to ventilate the body than dogs with a normal skull. According to the latest report of the FCI Scientific Committee (Sainio et al. 2020), it is the brachycephalic airway syndrome (BAS) that is directly responsible for breathing troubles, which consequently impedes proper thermoregulation through intolerance to heat and exercise, even leading to cyanosis and collapse.

The ocular syndrome of brachycephalic breeds

The structure of the skull of brachycephalic dogs, including in particular the shallow eye sockets and the associated exophthalmos, may increase the incidence of visual disorders (Packer et al. 2015a). Brachycephalic ocular syndrome (BOS) includes many conditions, such as lagophthalamos, euryblepharon, medial entropion (in-rolling of the eyelid, constantly irritating the cornea), exotropia and ectropion. Ocular diseases are most common in pugs (16.25% incidence), and corneal disorders are the second most common disorder in pugs after obesity (8.72% of dogs); eye infections (7.53%) are in third place (O'Neill et al. 2017).

Shallow eye sockets and minimal eye protection from the orbital bones make the short-skulled dogs' eyeballs stick out. In some cases, this defect is so severe that it is impossible to completely close the eye, and thus the eyeball is insufficiently protected, leading to irritation and drying of the cornea. The above condition may cause the eyeballs to fall out during greater physical exertion (e.g. fighting another dog), which may lead to the need to remove the eyeball (Gilger et al. 1995).

One of the more common eye diseases in brachycephalic dogs is corneal ulceration, which can lead to scarring or perforation of the cornea, and even to blindness (Packer et al. 2015a). According to Packer et al. (2015a), brachycephalic dogs are twenty times more likely to develop corneal ulceration than other dog breeds, and pugs are the most at risk of these breeds. It was found that the selection towards shallow eye sockets and wide orbital openings significantly increases the risk of this ailment. Nasal folds, whose hair irritates the cornea of the eye, also contribute to the occurrence of this disease. The authors found that dogs with nasal folds are almost five times more likely to develop corneal ulceration than dogs without nasal folds (Packer et al. 2015b).

Another medical condition that often occurs in short-skulled dogs is entropion, a condition when the eyelid turns inward. Shallow eye sockets and protruding eyeballs prevent the eyelids from properly spreading the tear film over the eyeball, and this can lead to an eyelid inward folding. Krecny et al. (2015) and Maini et al. (2019) reported that the incidence of entropion in pugs can range from 94.1% to 100%. Eyelid entropion and insufficient tear film causes the eye to be constantly irritated, which can lead to another condition, such as pigmentation of the eye cornea (pigmentary keratitis), which is very common in pugs. Maini et al. (2019) found this condition in both eyes in over 87% and in at least one eye in over 90% of pugs. Also Labelle et al. (2013) found them in over 82% of this breed of dogs.

Another common eye disease of brachycephalic dogs is distichiasis, which consists in the presence of an additional row of eyelashes on the eyelid that curl inward, causing constant irritation of the cornea (Raymond-Letron et al. 2011, Krecny et al, 2015, Zimmerman and Reinstein 2019). Ioannides et al. (2020) found recently that the brachycephalic breeds, and especially the English bulldogs, are most susceptible to developing distichiasis. According to these authors, brachycephalic breeds with distichiasis constitute as much as 62% of cases, and among them as much as 42% are English bulldogs. The authors also found that the treatment of the disease significantly increases the quality of life of dogs, however, they should be subjected to constant veterinary control due to the predisposition to relapse, which according to Gómez et al. (2020) can occur in up to 46% of dogs.

In addition to the above, brachycephalic dogs suffer from a variety of other eye conditions that should be addressed in a separate study. Also noteworthy is the problem with the amount of tears secreted, which in brachycephalic dogs is smaller compared to other breeds and also has lower-quality tear films, making their eyeballs more susceptible to mechanical irritation (Labella et al. 2013, Bolzanni et al. 2020).

Dental problems

Dogs have 42 teeth with a fixed tooth pattern. A shortened muzzle in brachycephalic dogs, and thus the lack of space to accommodate all the teeth, leads to malocclusion, the associated tendency to excessive tartar deposit and gingivitis (Bellows et al. 2019). Short-skulled dogs, due to the occurrence of undershot bite, have such a problem with feeding that some food companies offer it in appropriate shapes that facilitate eating by these dogs. The jaw in brachycephalic dogs is too short compared to the mandible, therefore there is a very traumatic contact between the maxillary incisors and the mandibular structures, which often leads to pulpitis and necrosis in the maxillary incisors (Hale 2013). As a result of the shortening of the jaw, strongly dense palatine folds form between which hair, food and bacteria can collect, which can lead to chronic inflammation of the palate (Hale 2013). O'Neill et al. (2020) found that the dentition problem affects almost 14% of brachycephalic dogs.

Reproductive problems

Many breeds of dogs today are predisposed to heavy deliveries, leading to the loss of puppies and the need for caesarean sections. A study of 151 dog breeds showed significant differences depending on the race in the cesarean section birth rate, ranging from 0% to 92.3% (Ewans and

Adams 2010). Most often, reproductive problems occur within miniature breeds (e.g. Chichuachua, Yorkshire terrier, Pomeranian), where the fetus is often too large in relation to the birth canal, and brachycephalic breeds, which in turn have problems with birth due to a specific anatomical structure. It is widely accepted that brachycephalic breeds such as bulldogs and Boston terriers are particularly prone to obstructive dystocia (Johanson et al. 2001).

Due to their conformation, English bulldogs are not only unable to take care of hygiene on their own, but more than 80% of their pregnancies (including French bulldogs) end with the necessity of a caesarean section (Evans and Adams 2010). Wydooghe et al. (2013) observed an even higher percentage (almost 95%) of deliveries with cesarean section in English bulldogs. These authors report that their cause is dystocia caused by the narrow pelvic canal of the bitch, the large head and the wide chest of the puppies (Forsberg and Persson 2007). Among all dog breeds, dystocia occurs in approximately 5% of dogs. In brachycephalic breeds, the risk of difficult births may increase up to 100% (Jackson 1995, Linde-Forsberg 2005, Bergstrom et al. 2006).

In studies conducted by Wydooghe et al. (2013) found that as many as 13% of English bulldog puppies are stillborn, and more than 8% of live puppies were diagnosed with developmental disorders. The most common of these are cleft palate (palatoschisis) and anasarca. These abnormalities, in particular the anasarca, increase the volume of the fetus, preventing it from passing through the birth canal. In addition, these authors found that at the end of pregnancy, more than 25% of bitches suffered from respiratory problems and partial anorexia.

Forsberg and Persson (2007) found that problems with birth in brachycephalic dogs worsen with age, and so, for example, in boxers, veterinary assistance during labor is necessary from the age of four. The cesarean is a burden not only for the bitch, but also for the puppies. Anesthesia during cesarean section surgery, i.e. any anesthetic used that penetrates the blood-brain barrier, penetrates through the placenta to the fetus, i.e. any anesthesia given to a female dog also affects puppies, which is not indifferent to their health.

One-fetus pregnancies are also a problem, as they make it difficult to determine the age of pregnancy during the ultrasound examination and, consequently, to determine the date of delivery. In addition, in such cases, there is a tendency to prolong the pregnancy, excessive growth of the fetus, which results in a misbirth.

Conclusion

The study does not describe all health problems of brachycephalic dogs, e.g. dermatological problems could fill up a separate extensive study. The described health problems of dogs affect not only the quality of life and welfare, but also the longevity of these dogs. According to many reports, an average life expectancy of an English bulldog is now just over 6 years, and one of the most common causes of their death is a heart failure (Adams et al. 2010). Knowledge of the health problems typical of certain breeds should alert dog owners, breeders and veterinarians, and will also help to take measures to improve the health and, above all, the well-being of the dogs.

The modern dog breeding aim at animals that are functionally healthy, have a breed-specific build and behavior, and live a long, healthy and happy life. As the veterinarians of Valley Vets pointed out, the goal of everyone who cares about the welfare of dogs should be to eliminate health problems. Unfortunately, the opposite is currently happening – the brachycephalic type is desirable, with as flat a face and bulging eyes as possible, and breeders try to obtain such puppies without looking at the consequences of the lack of comfort in such a dog's life.

According to the report of the FCI Scientific Committee (Sainio et al. 2020), steps should be taken to reduce the occurrence of health problems in brachycephalic dogs, also through a thorough analysis of the causes of their formation, the use of exercise tests, and ending with the selection and removal of dogs with health problems from breeding. These tests are already used by some Kennel Clubs and are accepted by breeders and dog owners. It may also be helpful to establish a standard for the above breeds that would describe the morphological traits that ensure the health and full functionality of the dogs. The above report even stated that Kennel Clubs should try to promote dogs not predisposed to BAS while discouraging as much as possible from breeding affected dogs. The breeding stock should be composed of dogs free from any clinical symptoms of BAS and having such anatomical features that reduce the risk of health problems, which requires close cooperation between dog owners, breeders, veterinarians and kennel judges (Liu et al. 2017, Sainio et al. 2020).

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