Brachycephalic Dogs & Cats

Discussion Paper

1. Background

Domestic dogs (*Canis familiaris*) display considerable variation in morphology, particularly skull shape.[1,4] Three overall terms are used to broadly designate head shape: dolichocephalic, mesocephalic and brachycephalic. Brachycephalic dogs are those dogs with a wide and short head.[3] Brachycephalic breeds include the Pug, French Bulldog, English Bulldog, Boxer, Boston Terrier and Pekingese. Brachycephalic dogs are increasingly popular, two brachycephalic breeds (Pug and Cavalier King Charles Spaniel*) were among the top ten pedigree dog breeds listed in the 2012 Australian National Kennel Club (ANKC) registration statistics.[22] Registrations for breeds such as the French Bulldog and Boston Terrier have doubled between 2008 and 2012.[22]

Brachycephaly is associated with a number of medical conditions that can compromise the welfare of affected animals:[1,10]

- Respiratory disease – including brachycephalic airway syndrome.
- Neurological disease – including syringomyelia.
- Ocular disease – including pigmentary keratitis and corneal ulceration.
- Gastrointestinal abnormalities and disease.

Brachycephalic airway syndrome (BAS) occurs as a result of hereditary anatomical abnormalities associated with this skull shape. Components of this syndrome include one or several of the following: stenotic nares, undersize nasal chambers with malformed nasal conchae, elongated soft palate, everted laryngeal ventricles (saccules), laryngeal collapse and hypoplastic trachea.[11,12] BAS is a progressive disease and clinical signs tend to worsen with age. Symptoms include exercise, heat and stress intolerance, snoring, stridor, cyanosis, syncope and collapse.[11] Brachycephalic dogs have been found to be 38 times more likely to have BAS than non brachycephalic dogs.[5]

The following is a summary of welfare concerns associated with BAS:[12 (p91)]

- 'Has the potential to affect large numbers of animals; all brachycephalic dogs may be respiratory compromised to some degree, with > 10 breeds reported with this disorder in case series internationally.'
- 'Has the potential to continue to do so generation after generation into the future due to its inherent link with the brachycephalic conformation - if dogs with at-risk conformations continue to be bred then this problem will be perpetuated.'
- 'Can have a severe adverse impact on animals' feelings; affected dogs are reported to be in chronic respiratory distress, thermal and physical discomfort, and experience behavioural restriction due to their impaired physical capabilities.'

* CKCS are not always classified as brachycephalic dogs

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- 'These effects can be of long duration, potentially affecting the dog for a large part of, or throughout, its life.'
- 'Owners of brachycephalic dogs have been found to underestimate the severity and frequency of breathing problems and there is a lack of recognition that signs of brachycephalic airway syndrome are a problem requiring veterinary attention. Instead owners can perceive signs as normal for the breed'.[12,11]

2. Potential objective measures for brachycephalic animals

a. Genetics

Dog breeds are defined by a specific combination of behavioural, morphological and coat colour traits. Many of these traits are shared between breeds of dogs.[1] It is likely that genetic modifiers exist for brachycephaly[1]and it is thought that brachycephaly is a semi-dominant trait.[19] The exact genes responsible have not yet been identified[20] but are thought to be located in Cfa1 (canine chromosome 1)[1].

<u>Limitations of genetics:</u>

- Gene(s) not yet identified, BAS not likely to be amenable to genetic screening similar to other heritable diseases.

b. Skull measurements

It has been found that skull measurements and those on live dog heads correlate well.[2] Measurements reported in the literature include:

I. Cephalic index

Cephalic index is obtained by dividing skull width by skull length (skull width/skull length x 100).[4] This requires no specialised equipment.

- Skull width - widest interzygomatic distance.
- Skull length - nose to external occipital protuberance.

II. Skull index

Skull index is calculated in the same way as cephalic index but the measurement definitions for skull length differ slightly.[3] Brachycephalic breeds exceed other head shapes in this index. Skull index has been measured at between 80-100 in brachycephalic dogs and has been defined as an index greater than 81 in *Miller's Anatomy of the Dog*.

- Skull width - widest interzygomatic distance.
- Skull length - inion to prosthion.
    - Inion - most prominent projection of the occipital bone (external occipital protuberance).
    - Prosthion - most forward projecting point of the anterior surface of the upper jaw.

III. Craniofacial angle

Craniofacial angle is the angle formed by the basilar and facial axes. The basilar axis is achieved by joining the basioccipital bone to the caudal margin of the chiasmatic groove. The facial axis is determined by the caudal prolongation of the projection of the hard palate. Lateral radiographs are required for this measurement. It has been noted that measurements for the basilar axis differ between authors.[6]

The craniofacial angle has been defined in *Miller's Anatomy of the Dog* as $9\text{-}14^0$ in brachycephalic dogs, $25\text{-}26^0$ in dolichocephalic greyhounds and $19\text{-}21^0$ in mesocephalic dogs, with no statistically significant differences between genders.[6]

IV. Facial index

Facial width (widest interzygomatic distance x 100)/ facial length (nasion to prosthion)).[3] Brachycephalic breeds exceed other head shapes in this index.

- Nasion - lies at the root of the nose where frontal and nasal bones unite.
- Prosthion - most forward projecting point of the anterior surface of the upper jaw.

V. Craniofacial index

A ratio of muzzle length to cranial length has been published.[12] No specialised equipment is required. It is described as a potential risk factor for BAS as it reflects the degree of skeletal shortening of the muzzle. Dogs affected with BAS had ratios that spanned into those described as ambiguous for BAS – therefore there does not appear to be a natural 'cut-off point'. A nares ratio has also been reported, using photographs of nares to measure degree of narrowing. Dogs affected with BAS had smaller nares ratios compared to unaffected dogs.[12]

Limitations of skull/head measurements:

- Whilst skull measurements define a dog as brachychephalic, there is no consensus on which measurements are standard.[10]
- Approaches to measurements are different between schools of thought (e.g. Anglo-Saxon vs. German).[9]
- There is no reported correlation between degree of brachycephaly in terms of skull measurements and severity of clinical signs. Packer, Hendricks & Burn (2012, p91) report that 'research to quantify the risk of brachycephalic airway syndrome across the spectrum of cranio-facial indices, and the creation of quantitative limits to these extreme conformations, is required to help refine breed standards in line with health and welfare.'

c. Measures based on clinical examination

Some authors suggest examining brachycephalic dogs as puppies, evaluating for stenotic nares, signs of stridor or stertor with restraint and any evidence of increase respiratory effort. It is also suggested that an upper airway examination is conducted under light anaesthesia to examine the soft palate, laryngeal ventricles (saccules) and laryngeal function.[10]

Limitations of measurements based on clinical examination:

- There is currently a degree of subjectivity. A comprehensive and objective grading system would need to be devised.
- Inter-observer reliability would need to be demonstrated for above grading system.
- Need for a veterinary examination.
- Risks of anaesthesia are greater in brachycephalic dogs (consensus required that this does not outweigh the benefits).
- A measurement scale derived to assess BAS will not address other abnormalities associated with brachycephalic breeds (i.e. ocular disease, GI disease, neurologic disease).
- Clinical signs do not remain static over the lifetime of the animal.

3. Brachycephalic cats

Brachycephalic cat breeds include the Persian and British Shorthair. Brachycephalic cats are reported to be at higher risk of developing respiratory, visual and olfactory disorders as a result of their head shape.[13] Cats do not generally appear to suffer from BAS in the same way as dogs do but there have been case reports in the literature.[18]

Skull Computed Tomography (CT) has been used to ascertain how brachycephalic head shape affects nasolacrimal drainage in cats. This study categorised brachycephalic head shapes from one to five (based on position of canine teeth, degree of jaw rotation and neurocranium shape) and demonstrated that the more severe the brachycephaly the more distorted the nasolacrimal drainage system. The authors reported that the degree of rotation of the upper canine teeth can provide a basis for classification of brachycephalia in cats and make breeding recommendations. In Germany it is prohibited to breed from brachycephalic cats in which the tip of the nose is higher than the level of the lower eyelid, and which show other anomalies of the facial bones. [21]

4. Conclusions

- Brachycephalic head shape is associated with several health problems, the most significant being BAS due to its chronicity and potential to cause severe and potentially life threatening health consequences.

- The significance of the deleterious impact on the health and welfare of brachycephalic head shape is widely supported in the veterinary/welfare literature.

- In Australia although the exact prevalence of disease associated with brachycephaly is unknown it is likely to be a significant problem owing to the popularity of brachycephalic breeds.

- The exact mode of inheritance of brachycephalic head shape is currently unknown but is the subject of research.

- There are several measures available but currently a system of consistent and objective measures for brachycephalic head shape and/or clinical signs is not yet in place. With the information currently available it is likely to be difficult to stipulate a specific head shape/degree of clinical signs beyond which dogs should not be bred.

- Given brachycephalic head shape appears to correlate with clinical signs in cats there may be potential to make breeding recommendations based on head CT assessment.

5. Areas for potential further research and development

- Development of a brachycephalic airway syndrome measurement scale (a system such as hip scoring for hip dysplasia) that could be used to make recommendations on breeding.
    - There are established methods of grading tracheal diameter and laryngeal saccule eversion but methods for other aspects would need agreement.

- Follow up on research findings published in veterinary and/or welfare literature regarding skull measurement correlation with brachycephalic airway syndrome by Rowena Packer – Royal Veterinary College London (as of 2014 reported to be awaiting peer review/publication).
    - This author has held a conference ‘Building Better Brachycephalics’ to disseminate her PhD findings (relating to head shape and disease risks), delegates included vets, charities, breeders and Kennel Club representatives. Majority agreement was reached ‘that numerical thresholds should be used in breed standards to limit muzzle length and eye size’.

    - Published information may provide a basis on which to develop objective brachycephalic breed standards.

- The feasibility of establishing a grading system for brachycephalic cats based on head CT assessment.

- Public education campaigns relating to the welfare of brachycephalic dogs and cats.

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