Developmental Abnormalities of the Canine Skull

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ABSTRACT

Fox, M .W., The Jackson Laboratory, Bar Harbor, Maine. Developmental Abnormalities of the Canine Skull.

Prognathism of the upper jaw and partial agnathia of the lower jaw and related disorders including dental anomalies, palatitis, and otocephaly are described. Similarly, secondary or concurrent anomalies associated with brachygnathism are discussed where an excess of soft tissue in proportion to the size of the upper jaw and facial (brachyfacial) area may cause a variety of clinical conditions. The higher incidence of neoplasia of the CNS in brachycephalic dogs may be related to reduction in cranial capacity in proportion to brain volume and pressure changes are less easily compensated in the brachygnathic breeds.

This paper is intended to correlate certain abnormalities that may arise secondarily to an inherited skull abnormality, and to review some of the skeletal defects of the canine skull that have already been reported.

The shape and proportions of the canine skull are governed by inherited factors which are not obvious in the newly born but emerge as postnatal development continues. Upper and lower jaw disproportions may not therefore be diagnosed with certainty in the neonate dog.

By crossbreeding different types of dog (dolicocephalic, mesocephalic, and brachycephalic) a wide spectrum of hybrid variations have been produced (1) and it was concluded that the length of the upper jaw is inherited independently of the lower jaw and vice versa.

The following skull abnormalities will be discussed in relation to secondary abnormalities of the soft tissues.

Prognathism (lengthening of the upper jaw). The genetics of partial agnathia (shortened lower jaw) has been reported in the Dachshund (2). Reduction in the length of the horizontal ramus of the lower jaw may cause malocclusion of the incisor and canine teeth, while occlusion in the molar region is relatively normal (Fig. 1a). The upper jaw therefore appears too long. Hypoplasia of the dental enamel (1) and deletion of teeth or retention of permanent teeth with partial or maleruption (personal observation) may also be seen. Traumatic palatitis in the post-incisor region has been seen in severe cases of prognathia.

Prognathia with partial agnathia of the lower jaw has been reported in a syndrome of otocephaly affecting a strain of Beagles (3). Other abnormalities included mild hydrocephaly, epilepsy, and cranioschisis (parietal bone defects). The tongue in some severe cases of prognathia appeared oversized. One pup was born in this line which exhibited agnathia (no lower jaw) and absence of all craniofacial structures anterior to the occipital cortex (Fig. 2). This was regarded as a high grade (lethal) otocephalic.

Closure of the parietal fontanelles normally occurs soon after birth but in the Chihuahua closure is often delayed (7). Patency of these fontanelles may persist in hydrocephaly and in the adult low grade otocephalic (3 op.cit.) (Fig. 3). The genetics of a similar developmental calvarium defect has been described in the Cocker Spaniel (4).

Brachygnathism (shortening of the upper jaw). (Fig. 1. b & d). Although this condition may arise spontaneously in mesocephalic breeds, it is maintained as a breed characteristic in the brachycephalic (bulldog) type, and secondary abnormalities of soft tissues are often associated with this condition.

Due to extreme reduction of the maxillary region, abnormal development of the nasal alae and turbinate bones may occur with subsequent respiratory dyspnoea. Secondary laryngeal collapse has been reported in relation to these conditions (5). Oversize of the tongue may occur, although the tongue would fit a skull of normal maxillary proportions; this then may be relative

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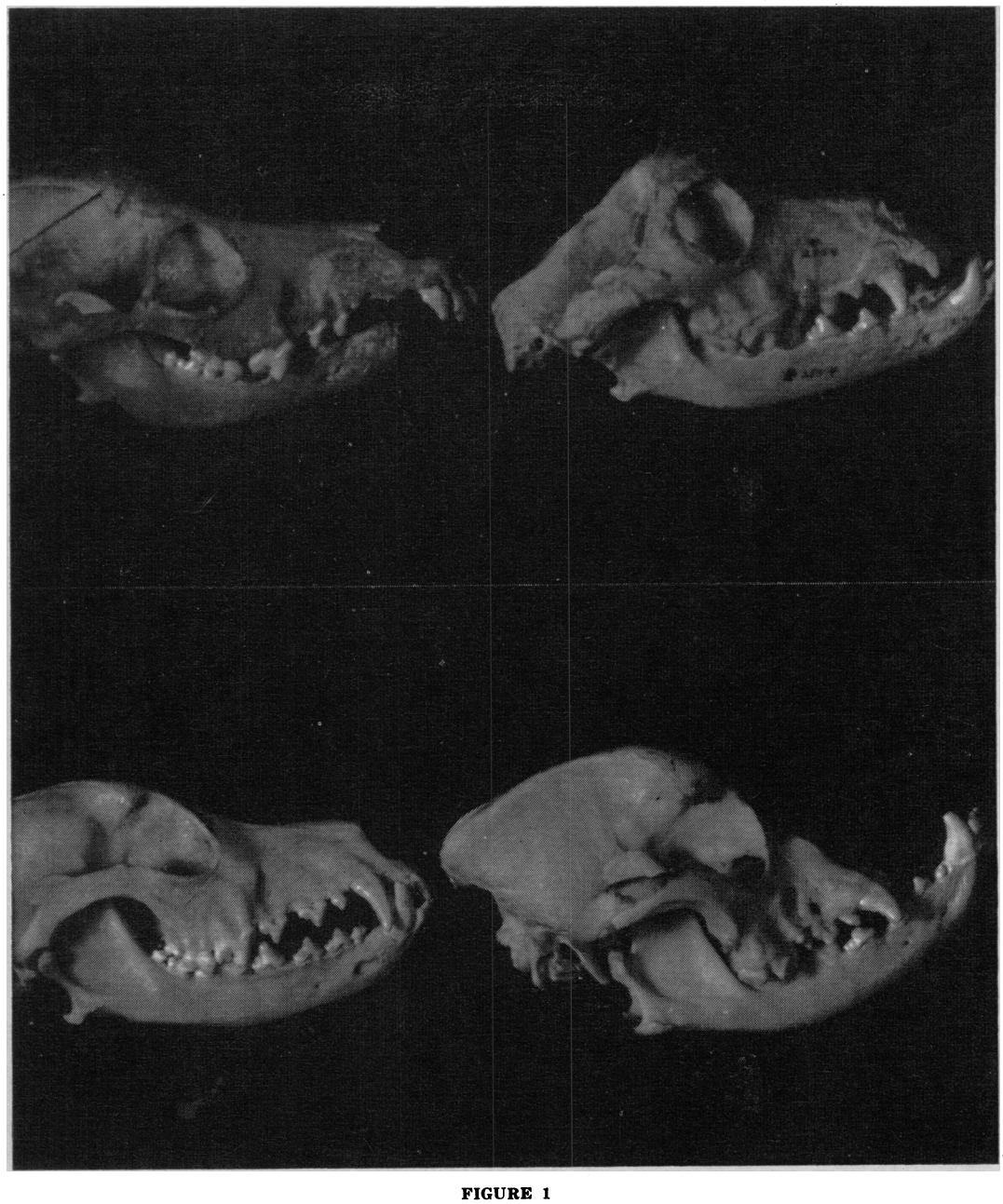

FIGURE 1

A. Prognathism in a Beagle.

B. Brachygnathism in a Beagle.

C. Normal (Mesocephalic) Beagle skull.

D. Brachycephalic (Bull dog) skull.

oversize of the tongue. The tongue may be protruded continually and has been mistaken for hypoglossal paralysis. Elongation of the soft palate is a common anomaly in brachyfacial breeds and contributes to respiratory embarrassment, heat stroke, laryngeal collapse, and the reverse sneeze syndrome (6). This disproportionate size of soft tissue may be absolute oversize. Some brachycephalics have fairly normal skull: soft tissue proportions white in others the amount of soft tissue greatly exceeds the

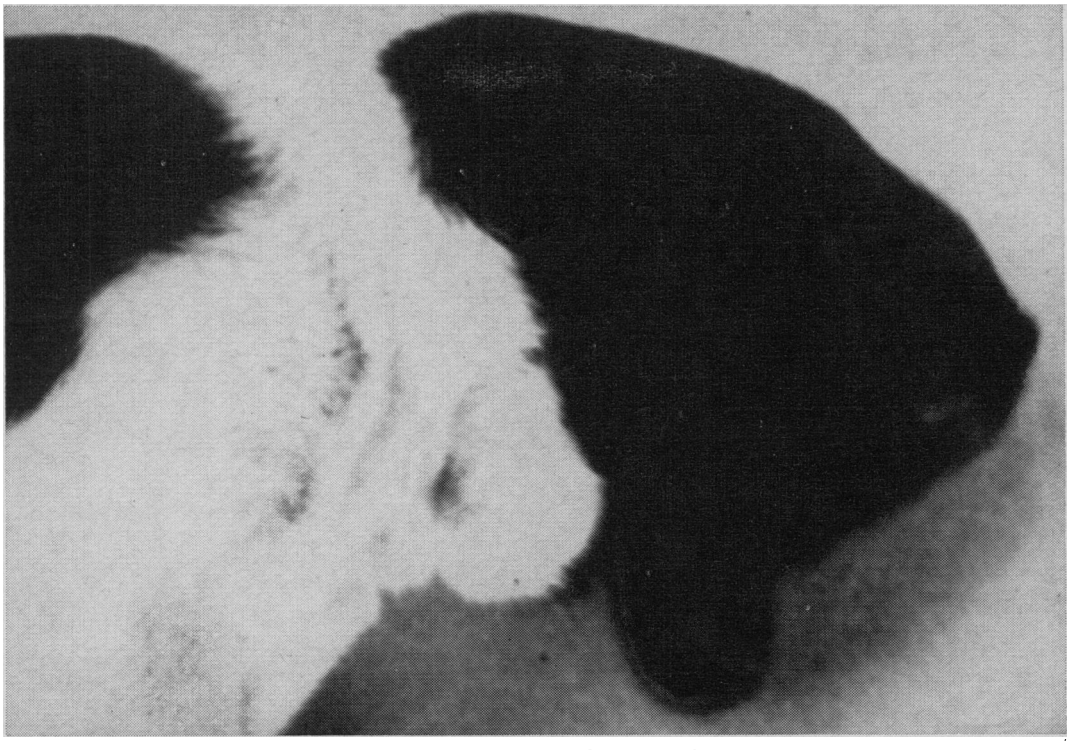

FIGURE 2. Head of a high grade Otocephalic Beagle. Note, complete astomia and anophthalmia.

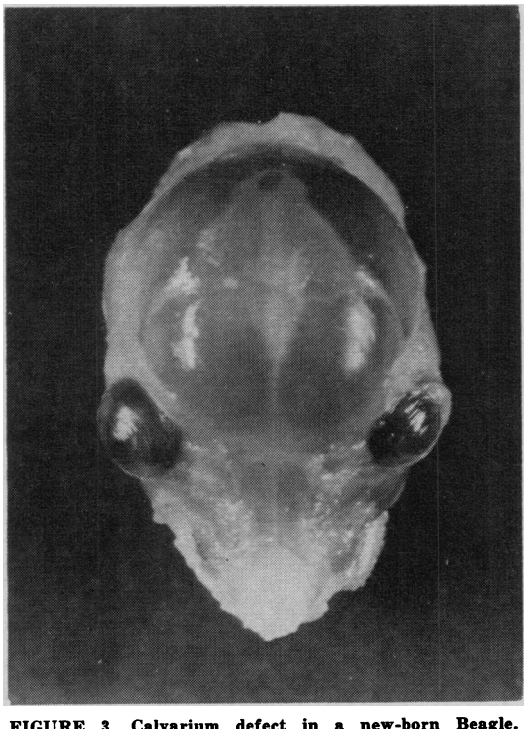

FIGURE 3. Calvarium defect in a new-born Beagle. (Cranioschisis.)

skull proportions. Dermatitis of the skin folds is common in these breeds where excessive facial skin forms corrugations and pyo-traumatic dermatitis develops.

The shape of the cranium in the brachycephalic may in part account for the high incidence of tumors in these breeds (7) (8). With reduction of the anterior (maxillary) part of the skull and compression of the frontal region into an almost vertical position, it is possible that alterations in intracranial pressure produce more dramatic symptoms than in meso- and dolichocephalic breeds. A cone of pressure is built up by the tumor and compensatory shifting of the brain may not occur so that symptoms are more frequently seen in these breeds and neoplasia of the CNS more frequently diagnosed clinically than in other breeds. The impression that brachycephalic dogs more frequently develop tumors of the CNS may be incorrect, because normally asymptomatic lesions, by virtue of the shape of the cranium, cause greater increases in intracranial pressure. In the canine cranium there is only limited opportunity for shift of the brain

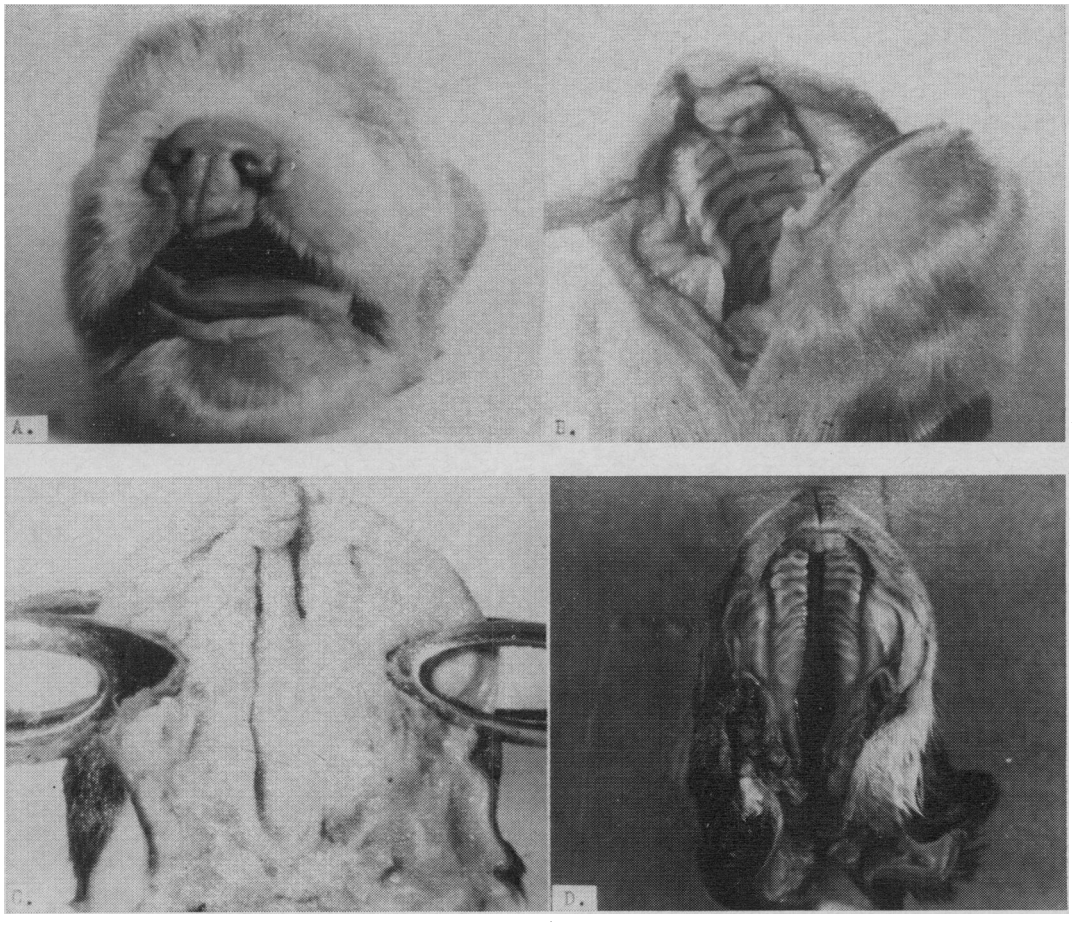

FIGURE 4.

A. and C. Hare-lip and cleft palate in a Cocker Spaniel. B. Hare-lip and anterior palatine defect in a Bull dog. D. Cleft palate (palatoschisis) in a Beagle.

stem in a rostro-caudal direction for the cranium is small and the tentorium cerebelli is bony and rigid, but brain stem displacement due to tumor pressure occurs especially laterally and dorsally (9). Pressure changes may be less readily compensated therefore in the brachycephalic where there is additional structural compression of the frontal bones and reduction of the rostral space. Secondary internal hydrocephalus may develop more easily under such circumstances. Cleft palate and harelip, seen either singly or concomitantly, are commonly seen in brachycephalic breeds. (Fig. 4). Palatoschisis or slight cleft palate may not be noticed and all pups from such breeds should be examined carefully for low grade defects and eliminated from the breeding program.

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