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Atlantoaxial Instability in a White-tailed Deer Fawn (*Odocoileus virginianus*)

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ABSTRACT: On 14 March 2001, an 8 mo old, male white-tailed deer (*Odocoileus virginianus*) was found in lateral recumbency exhibiting neurologic signs including inability to rise, opisthotonus, paddling, and respiratory distress. There was evidence of minor cranial trauma. Postmortem examination revealed atlantoaxial instability with ventral deviation of the axis due to malformation of the caudal atlas and cranial axis. Given the age of the fawn, the instability was assumed to be congenital with minor trauma inducing severe, acute neurologic signs.

Key words: atlas, axis, deer, *Odocoileus virginianus,* subluxation, vertebrae.

Atlantoaxial instability, also known as atlantoaxial subluxation, is an uncommon condition in domestic animals including dogs, cattle, horses, sheep, goats, and a cat (White et al., 1978; Robinson et al., 1982; Watson et al., 1985; Watson and de Lahunta, 1989). Instability can arise from trauma or alternatively as a congenital defect involving failure of fusion of the dens to the axis (Palmer, 1993). Luxation in spite of normal development of the dens can occur from acute trauma and rupture of the dorsal atlantoaxial, alar, and transverse ligaments. Clinical signs are due to spinal cord compression and may include respiratory failure and death. Congenital abnormalities, such as a hypoplastic dens, result in insufficient support between the atlas and the axis; therefore, even minor trauma may rupture the dorsal atlantoaxial ligament resulting in clinical signs. Dogs with congenital malformation of the dens may be asymptomatic or demonstrate chronic progressive clinical signs including cervical pain, mild ataxia, tetraparesis, or tetraplegia (Walker et al., 1985). In cattle, most cases are in calves younger than 12 mo old; clinical signs may range from variable degrees of ataxia to complete recumbency (White et al., 1978).

This report describes atlantoaxial instability in an 8 mo old, male, white-tailed deer (*Odocoileus virginianus*) that was part of a breeding herd at the National Animal Disease Center, Ames, Iowa (42°03′N, 93°63′W). Offspring from this herd are used for tuberculosis research, however, the fawn described was not part of a research project. On 14 March 2001, the deer was found in lateral recumbency, unable to stand, with the head extended in opisthotonus. All four legs were rigidly extended and uncoordinated paddling resulted in unsuccessful attempts to rise. The respiration rate was increased and the mucous membranes were cyanotic. Due to the poor prognosis, the animal was euthanized by intravenous administration of sodium pentobarbital. The fawn was found in the corner of a fenced pasture and inspection of the area revealed minor damage to the fence in this area.

Gross examination revealed a 3–4 cm laceration medial to the left antler bud. As the skin was reflected there was focally extensive hemorrhage in the musculature beneath the laceration. No other signs of trauma were noted. There was obvious ventral deviation of the vertebral column in the region of C1 and C2 (Fig. 1). Upon disarticulation of the C1–C2 junction malformation of caudal atlas and proximal atlas was apparent. The flesh was removed from the vertebrae by boiling for gross examination of the bone lesions. The caudal atlas was asymmetrical with the left caudal articular fovea being displaced dorsolaterally. The articular surface of the caudal articular fovea extended dorsally along the caudal rim of the left arch of the atlas (Fig. 2). The cranial aspect of the axis was also misshapen and asymmetrical. The dens

FIGURE 1. Lateral view of first and second cervical vertebrae from an 8 mo old white-tailed deer. Note ventral deviation of C2 and hypoplastic dens (arrow).

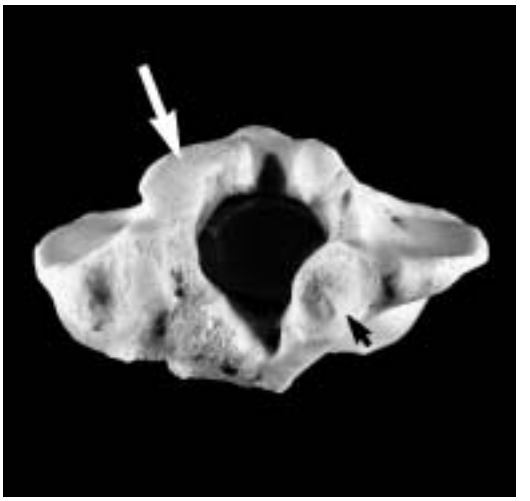

FIGURE 2. Caudal aspect of first cervical vertebra from an 8 mo old white-tailed deer. Note asymmetry with malformed left caudal articular fovea extending dorsolaterally along the caudal rim of the arch (long arrow). The right caudal articular fovea is in a more normal position (short arrow).

was hypoplastic and a thickened left ventral articular surface extended dorsally along the left cranial wall of the axis (Fig. 3). When articulated, the dens was misplaced ventrally creating an abnormal curvature to the vertebral canal. There was focal hemorrhage in the musculature above the C1 to C2 junction as well as hemorrhage around the spinal cord at this junction. Within the cord itself there was gross hemorrhage present within the gray matter. The spinal cord was removed intact from the proximal cervical region and immersed in neutral buffered 10% formalin. Brain, skeletal muscle from the neck and hindlimbs, kidney, liver and lung were also collected and immersed in neutral buffered 10% formalin. After fixation the spinal cord from C4 to the medulla was sectioned at 0.5 cm intervals and processed by routine methods. All tissues were processed routinely, sectioned at (5 μm), stained with hematoxylin and eosin, and examined by light microscopy. Histologically there were multifocal, variably sized areas of hemorrhage limited to the

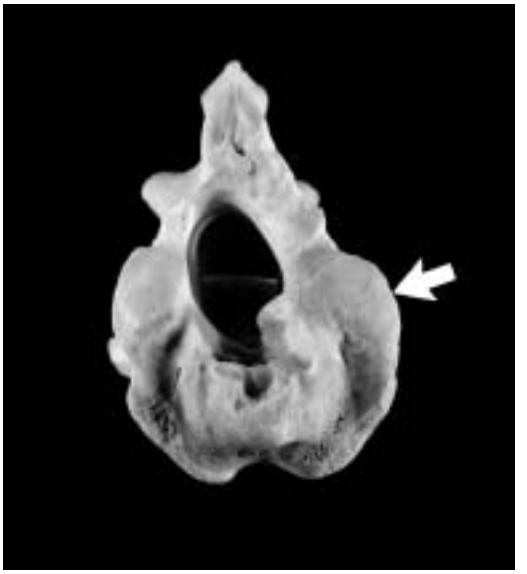

FIGURE 3. Cranial aspect of second cervical vertebra from an 8 mo old white-tailed deer. Note the misshapen and asymmetrical cranial aspect of the axis. A thickened left ventral articular surface (arrow) extends dorsally along the left cranial wall of the axis.

gray matter and most severe in the intermediate and ventral horns. Microscopic abnormalities of the brain or other organs were not seen.

Various anomalies of the axial and appendicular skeleton of white-tailed deer have been reported (Leipold, 1980). Although these include various anomalies of the skull (Jenks et al., 1986), to the author's knowledge, atlantoaxial instability has not been reported in white-tailed deer. A survey of arthropathies of free-living white-tailed deer of various ages revealed involvement of the vertebral column; however, only cervical vertebrae caudal to C2 were involved and the condition was not seen in deer less than 6 yr of age (Wobeser and Runge, 1975). In calves, fusion of the atlanto-occipital joint often accompanies atlantoaxial subluxation (Palmer, 1993). No abnormalities of the atlanto-occipital joint were noted in the present case.

Given the age of the animal it is likely that the condition described here was congenital. Although no gait abnormality or other neurologic signs had been noted in this fawn, a complete physical or full neurologic exam had not been done. It is probable that trauma associated with collision with the fence exacerbated the already existing instability, creating spinal cord compression and the acute onset of severe clinical signs.

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