Ventral fixation in atlantoaxial instability with axial fracture in a dog

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Summary
This study reports the diagnosis and the surgical management of atlanto-axial instability with an oblique axial fracture in a dog. The fracture was diagnosed by radiography and Computed Tomography (CT). In the CT views, the appearance of the distortion of the atlantoaxial articular surface was interpreted as instability. The stabilization was achieved with the cancellous screws. Following the surgery, the neurological status improved and the dog no longer had marked neurological deficits.

Keywords
Atlantoaxial instability, ventral fusion, axial fracture, dog

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Introduction
The cervical vertebrae are less likely to be fractured among the vertebrae of the spine because of their ability to move freely. However, atlas and/or axis are the most frequently involved segments of cervical vertebrae. The dens and/or body are the frequently fractured parts of the axis (4). Survey radiography and cisternal myelography, if atlanto-axial instability is not present, are the basic diagnostic procedures for the fractures of spine. However, the lack of three-dimensional view limits the interpretation of the vertebral lesion which can be obscured by errors of positioning in conventional radiography. Computed tomography (CT) allows a three-dimensional view of the fracture to be obtained and clarifies the involvement of the spinal cord (3).

The selection of the treatment procedure is based on information derived from the neurological and the radiological examinations (2, 4). According to the fracture type, site of vertebrae and multiplicity, plates, Steinman’s pins and polymethylmethacrylate, cervical spine locking plates, dorsal wiring, transarticular fixation pins and screws have been reported as surgical treatment methods (3).

The purpose of this report is to present the diagnosis of an axis fracture and atlantoaxial instability and treatment with ventral fixation by double lag screw stabilization.

Case report
A one-year-old, male Husky was referred to the Department of Surgery Faculty of Veterinary Medicine, Ankara University due to neck pain and abnormal gait. The owner reported that the dog had been lost for two days, and may have been involved in a dog fight. Physical and neurological examinations revealed ambulatory tetraparesis which was more pronounced on the left side. During the “wheel barrowing test”, the dog fell down to the left side. Severe neck pain elicited during palpation was an important clinical sign. Increased limb tone and spinal reflexes suggested an upper motor neuron lesion to all limbs. According to the referring veterinarian the neurological status had deteriorated, despite the conservative management including analgesics and neck cast extending from in front of the ears to behind the front legs.

The dog was sedated with a combination of 0.28 mg/kg diazepam and 5 mg/kg ketamine to permit radiographic examination. In survey radiography; ventrodorsal, lateral and slight flexion views of the cranial cervical region revealed malalignment of the atlantoaxial articulation in the ventral compartment. The fracture of axis was detected in the radiographic views (Fig. 1A, B). However, there was a doubt about the integrity of odontoid process and also the stability of atlantoaxial joint. CT was used to define the extent of the fracture and plan the surgical procedure. During CT examination, 0.02 mg/kg diazepam and 5 mg/kg propofol were administered for induction of anaesthesia and it was maintained by propofol as 0.3–0.4 mg/kg/min constant infusion with a drip set. The dog was placed on the prone position in the CT scanner. The cervical region was scanned with 3 mm slice
thickness from the atlanto-occipital joint to the third cervical vertebrae. According to the CT findings, narrowing of the spinal canal, fracture of the axial body on the left side and the distortion of the atlantoaxial articular surfaces of the axial body were observed (Fig. 2A, B and Fig. 3).

Ventral fixation of the atlanto-axial joint by cancellous screws and cancellous bone graft was planned on the basis of the computed tomography (CT) findings. The dog was premedicated with 0.01–0.02 mg/kg atropine sulphate e, and 0.005 mg/kg fentanyl f. Anaesthesia was induced with 5 mg/kg propofol and maintained with halothane g in oxygen following endotracheal intubation. The patient was aseptically prepared and placed in the dorsal recumbency and a midline skin incision was made from the intermandibular area to the level of the fourth cervical vertebra. The sternohyoideus muscles were separated along their midline to reveal the larynx, trachea, thyroid glands, esophagus, common carotid artery, and vagosympathetic trunk. These structures were carefully mobilized and retracted laterally along with the ventral cervical musculature. The longus colli muscles immediately ventral to the atlas and axis, were bluntly dissected along the midline, separated from their bony attachments, and retracted laterally.

The oblique fracture of the axis including the cranial articular surface was seen on the left side. Before stabilization, the articular cartilage of atlas and axis was removed and subchondral bone was exposed to allow the fusion of the atlanto-axial joint. Cancellous bone graft, which was harvested from the dorsal cranial surface of the right humerus, was placed over the fracture line and the articular surface. The type of fracture did not permit the fragments to interdigitate other because of this, the stabilization and fixation of fracture and atlanto-axial joint were achieved with 3.5 mm cancellous screws in lag screw manner (Fig. 4A, B). It was observed that the double lag screws application sufficiently stabilized the fracture fragments.

A neck cast including PVC (polyvinylchlorid) plastic as a support material extending from in front of the ears to the behind the forelimbs was used for external support. The dog received 30 mg/kg Methylprednisolone h and 30 mg/kg cefalosporin i before induction of anaesthesia. Cefalosporin and 4 mg/kg Carprofen j were continued every 12 hours for one week after the operation and ranitidine k was used as prophylaxis against gastrointestinal haemorrhage. The dog was hospitalized and examined daily for two weeks. Progressive improvement was noticeable during the examination period with regard to neurological and physiological evaluation. The monitoring of the incision site was carried out during hospitalization period and the neck cast was changed every month and not finally removed until the postoperative second month. Eight months later, the owner was contacted via phone and confirmed that

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e Atropin injectabl- Vetas, Istanbul, Turkey.
f Fentanyl Citrate, Abbott, Turkey.
g Halotan- Hoeschst, Istanbul, Turkey.
h Prednol 250mg-Mustafa Nevzat, Istanbul, Turkey.
i Cefizox 500mg- Eczacibasi, Istanbul, Turkey.
j Rimadyl injectabl- Pfizer, Istanbul, Turkey.
k Ranitab- Deva, Istanbul, Turkey.
the gait had been recovered completely, however slight neck pain had remained.

Discussion

The high relative incidence of fractures of the axis, particularly involving the vertebral body and pedicles, is attributable to the anatomical lack of dorsal facet joints between C1 and C2. The other predisposing factors are, poor dorsal ligamentous and tendinous support relative to the axial spine cranially and caudally and the weak characteristics of the cranial body of C2, particularly in axial bending. The type and region and the aetiology of the fracture for the present case were consistent with the literature.

Because of the intricate shape of the vertebrae throughout the spine, an accurate diagnosis of the site and severity of the cervical fracture/luxation is often difficult via survey radiography alone. Myelography can be used to reveal the suspected fracture/luxation causing compression to the cord (1). However, iatrogenic consequent trauma can be caused during these procedures. Computed tomography may enhance the clinician’s three-dimensional perspective of the fracture and better defines the position of the spinal cord with respect to the fracture segments. CT scanning has been found to be useful when diagnosing vertebral fractures, especially in suspicious cases and for detecting spinal cord compression. Obtaining images in different planes regardless of patient orientation during CT examination was the other important advantage in preventing iatrogenic spinal cord injury (3). According to the authors’ knowledge, the diagnosis of axis fracture by CT has not been reported.

Surgical and non-surgical treatment methods are used to stabilize the cervical fractures (2). The neck pain and the neurological deficit had deteriorated according to the referring veterinarian despite the use of a neck brace. In addition to the clinical signs, the instability of the lesion detected by radiography and by CT constituted the reason for deciding on surgical treatment.

Ventral double pin or screw placement, pins with polymethylmethacrylate, cervical spine locking plates, and dorsal wire applications have been used to stabilize cervical fractures and/or atlanto-axial instability (3). However, the relative superiority of these techniques to each other is unclear. Furthermore, only one veterinary study was performed comparing the four techniques of spinal fixation in dogs. That author’s findings suggested that dorsal cervical fixation, with screws, provided a more solid vertebra than the ventral plating, lag screw application and dorsal wiring (5). If the vertebral body fracture does not have the capacity to withstand axial compressive forces, then it will collapse or overlap. For this instance, some form of internal fixation that will buttress the fracture site is indicated such as vertebral body plating. Fixation applied dorsally under these circumstances would be exposed to large bending forces and be subject to the premature failure (4). In the present case, the plate could not be applied according to the main principles of plating, since there were not enough sites for at least two screws, and due to a considerable risk of failure in this area, the fusion and stabilization could be maintained with double cancellous screws and also the neck cast support.

Conclusion

This case report illustrated that the CT is superior to radiographic examination in defining the extent of traumatic vertebral lesions. The atlantoaxial instability and the oblique axial fracture were successfully treated by the ventral fixation with the double cancellous screws and the cancellous bone graft and post-operative neck cast.

References