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Ventral Fixation of Atlantoaxial Joint under Fluoroscopic Guidance Using Screws in a Chihuahua Dog

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Abstract : A 5-year-old Chihuahua dog was evaluated for a tetraparesis. The dog was presented with a non-ambulatory tetraparesis and neck pain. Radiography demonstrated an atlantoaxial (AA) subluxation and increased distance between the dorsal arch of the C1 and the dorsal spinous process of the C2. The AA joint was fixed with ventral transarticular fixation using two screws under fluoroscopic guidance. Neck brace was applied during 3 weeks post-operation. After 4 weeks, the dog was fully ambulatory with improved neurological function. Postoperative radiographs confirmed reduction of the luxation and no migration of screws. The dog showed complete resolution of clinical signs without signs of recurrence till 4 months after operation. Proper angulations of screws provided under fluoroscopic guidance, enabled adequate stabilization of the AA joints using ventral transarticular screw fixation which improved neurologic outcome of the patient.

Key words **:** atlantoaxial subluxation, ventral fixation, fluoroscopic guidance, screw, dog.

Introduction

Atlantoaxial(AA) subluxation is a traumatic or congenital condition in dogs and cats that causes cervical pain and neurological dysfunction (6,12). Commonly, affected dogs are small breed dog including Yorkshire Terrier, Chihuahua, and miniature Poodle. Clinical signs of AA subluxation consist of neck pain with or without neurologic problems ranging from proprioceptive ataxia to tetraplegia (1,3,15), while tetraparesis indicates more significant spinal cord compression (1). Many non-surgical methods have been described (3). However, since permanent rigid immobilization of atlantoaxial joint is regarded as the most important method of treatment, surgical stabilization of the joint is usually considered in dogs with moderate to severe neurological problems (1,3,7,8,15).

The two main approaches to the AA joint were dorsal and ventral. The dorsal approach relies on soft tissue components to maintain stability, however also have technical difficulty, implant failure and iatrogenic nerve damages (6,7,12). Other complications are failure of the fixation material, and poor anatomic alignment (1). Ventral stabilization of the AA joint allows reduction of the luxation, visualization and inspection of the dens, good stability (6,12,13,15), and proper anatomic alignment. It also promotes permanent fusion of the AA joint (14). However, there are some possibilities of damaging vital structures including laryngeal nerve and the vascular supply to the thyroid gland (6,12,13,15). The purpose of this report is to describe the successful surgical stabilization of a dog with AA subluxation with screws using a ventrally approach under fluoroscopic guidance.

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Case report

A five year-old female Chihuahua was presented to Konkuk University Veterinary Teaching Hospital (KUVTH) for evaluation of tetraparesis with extension of forelimbs. The dog had progressive lameness that started from left hindlimb to tetraparesis at 7 days prior to presentation. There was no history of trauma or other problems.

During the physical examination, palpation of the cervical spine revealed an asymmetrical positioning of the atlas and neck pain. Other neurological abnormalities included non-ambulatory tetraparesis and absence of conscious proprioception in all limbs. A complete blood count, biochemical panel, thoracic radiography, and abdominal ultrasonography were all normal.

The radiographic examination was performed under general anesthesia. On lateral radiograph, the gap between the dorsal arch of C1 and the spinous process of C2 was increased when the neck was flexed (Fig 1A). Dorsoventral view of radiograph demonstrated a rotation of the C2 vertebra to the left side (Fig 1B). Cerebrospinal fluid (CSF) obtained from the cisterna magna, and the analysis of CSF showed no

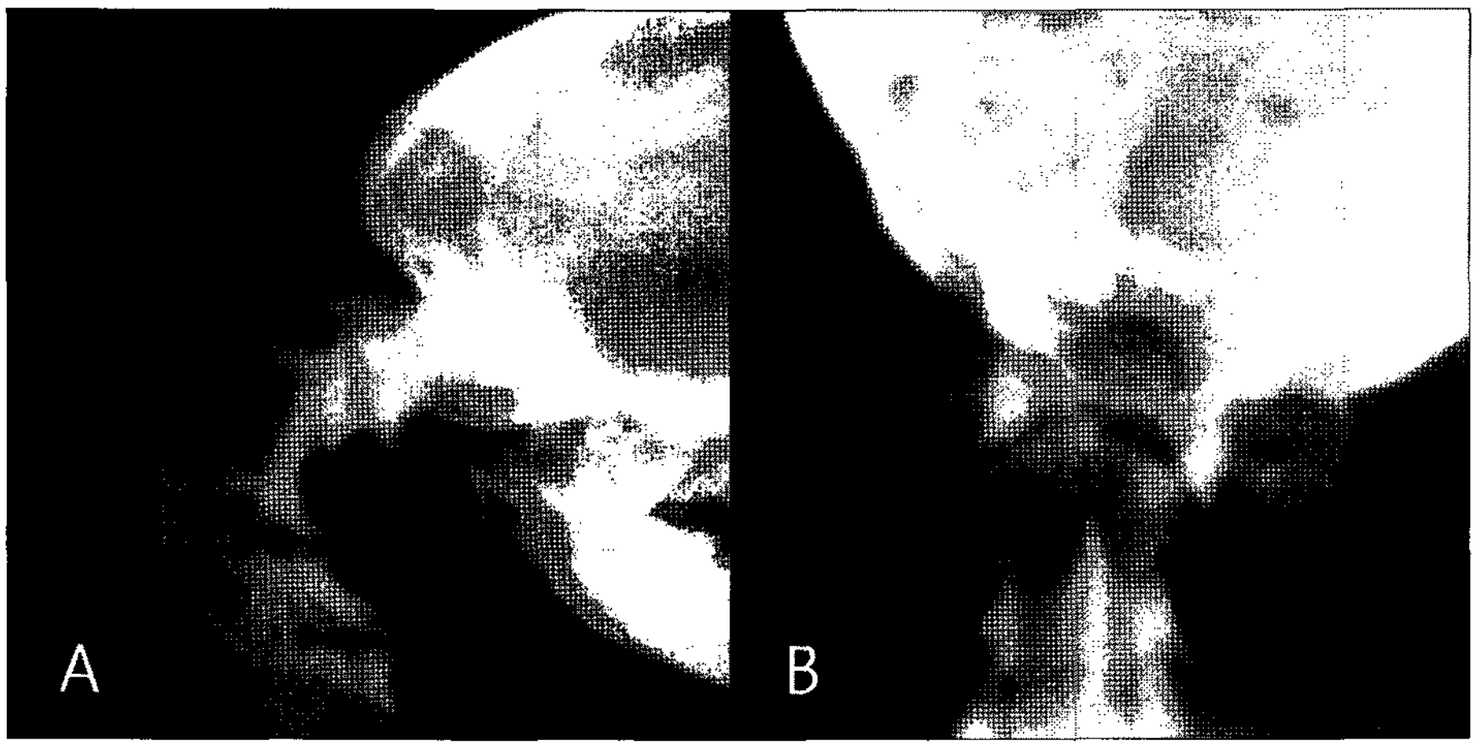

Fig 1. Radiographies of cervical region of the patient. (A) Lateral radiographs showing a marked increase in the gap between the dorsal arch of C1 and the spinous process of C2 when the neck is flexed. (B) Ventrodorsal radiographs showing subluxation of the AA joint.

Fig 2. (A) The skin incision is made on the ventral midline. The sternothyroideus muscles(arrow) are exposed, and (B) the left sternothyroideus muscle is transected.

significant finding. A diagnosis of the altlantoaxial subluxation was made.

Surgical procedure

The dog was premedicated with acepromazine 0.1 mg/kg, IM (Sedaject®, Sam-Woo Median Co., Ltd., Korea) and medetomidine 0.02 mg/kg, IM (Domitor®, Orion PharmaCo., Finland), and was injected with intravenous propofol (Anepol®, Hana Pharam Co., Ltd., Korea) at a dose of 6 mg/kg. Anesthesia was maintained using 1.5% isoflurane (Forane®, Rhodia Orgranique Fine Ltd., Korea) and oxygen (approximately 1.5 L/min) added to room air using an endotracheal tube.

After general anesthesia, the dog was positioned in dorsal recumbency with elevationof the cervical region and rigid stabilization of the body was secured with vacuum bean bags and medical tape. A ventral midline incision was made from the larynx to the hyoid arch. The sternothyroideus and sternocephalicus muscles were exposed and separated with blunt dissection (Fig 2A). And the sternothyroideus muscle was transected (Fig 2B). The trachea and esophagus were retracted by Senn retractor to protect them (Fig 3) and to visualize the longus colli muscles, on the ventral surface of the cervical vertebra. The tendons of the longus colli muscles were elevated caudolaterally from the body of C2 (Fig 4). The joint capsule of the C1 and C2 was incised and removed partially. The articular cartilage was removed with a curette and No. 11 blade. The luxation was reduced using reduction forceps placed across the ventral body

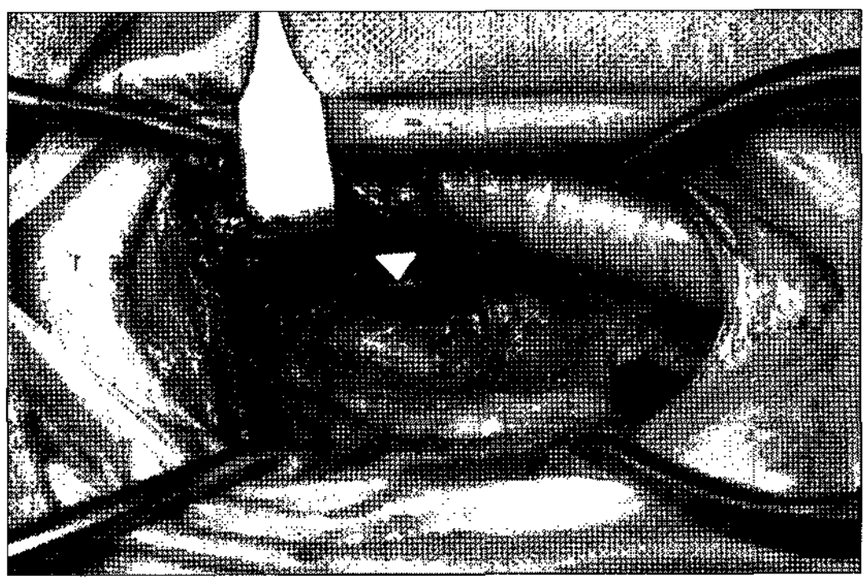

Fig 3. The trachea and esophagus are retracted by Senn retractor. The thyroid gland is visible(arrow head).

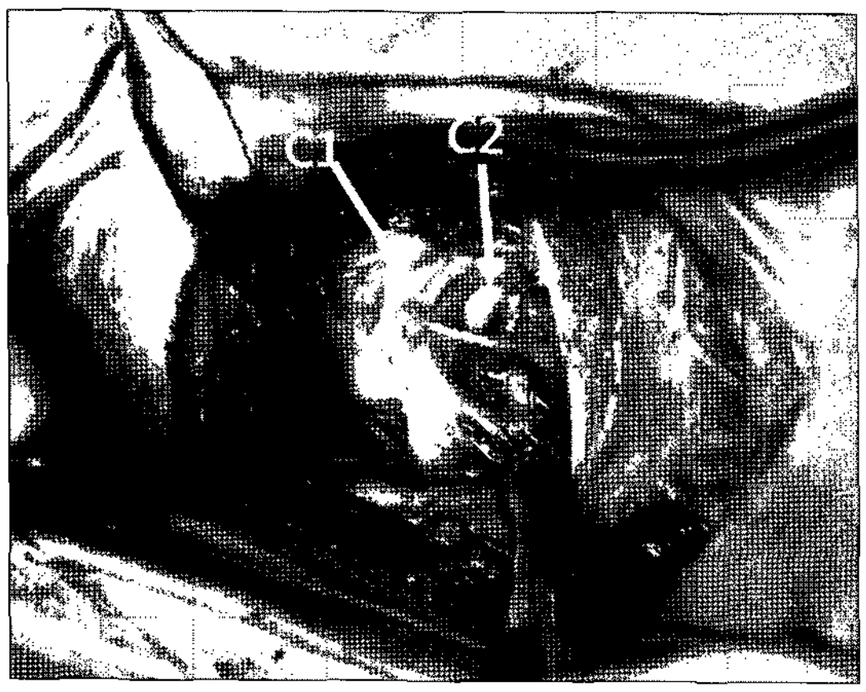

Fig 4. Caudolateral elevation of the longus colli muscle exposes the ventral aspect of the C1 and C2 vertebrae.

of C2, distracting the veterbra caudally while drilling. 1.5 mm holes were drilled in C2 and acrossed the articulation. Two screws (diameter 2 mm, length 11 mm) were inserted towards the alar notch of the atlas under fluoroscopic guidance (Fig 5). The screws were angled away from the midine at approximately 30° and downward at approximately 30° from horizontal. The longus colli muscle was apposed with absorbable suture and skin closure was routinely performed. Postoperatively, pain was controlled with buprenorphine (10 ug/kg, IM). Chlorampenicol (50 mg/kg, PO, bid) was given for prophylactic antibiotics.

Prognosis and follow-up

A neck brace was placed around the neck and strict cage rest was applied until 3 weeks post-operation. At 2 weeks after the operation, the dog showed weight-bearing and recovery of proprioception except the right forelimb. After 4 weeks, the dog was fully ambulatory with improved neurological function and postoperative radiographs confirmed reduction of the luxation

Fig 5. (A) Two screws are inserted towards the alar notch of the atlas and (B) the angulations of screws are confirmed under fluoroscopic guidance.

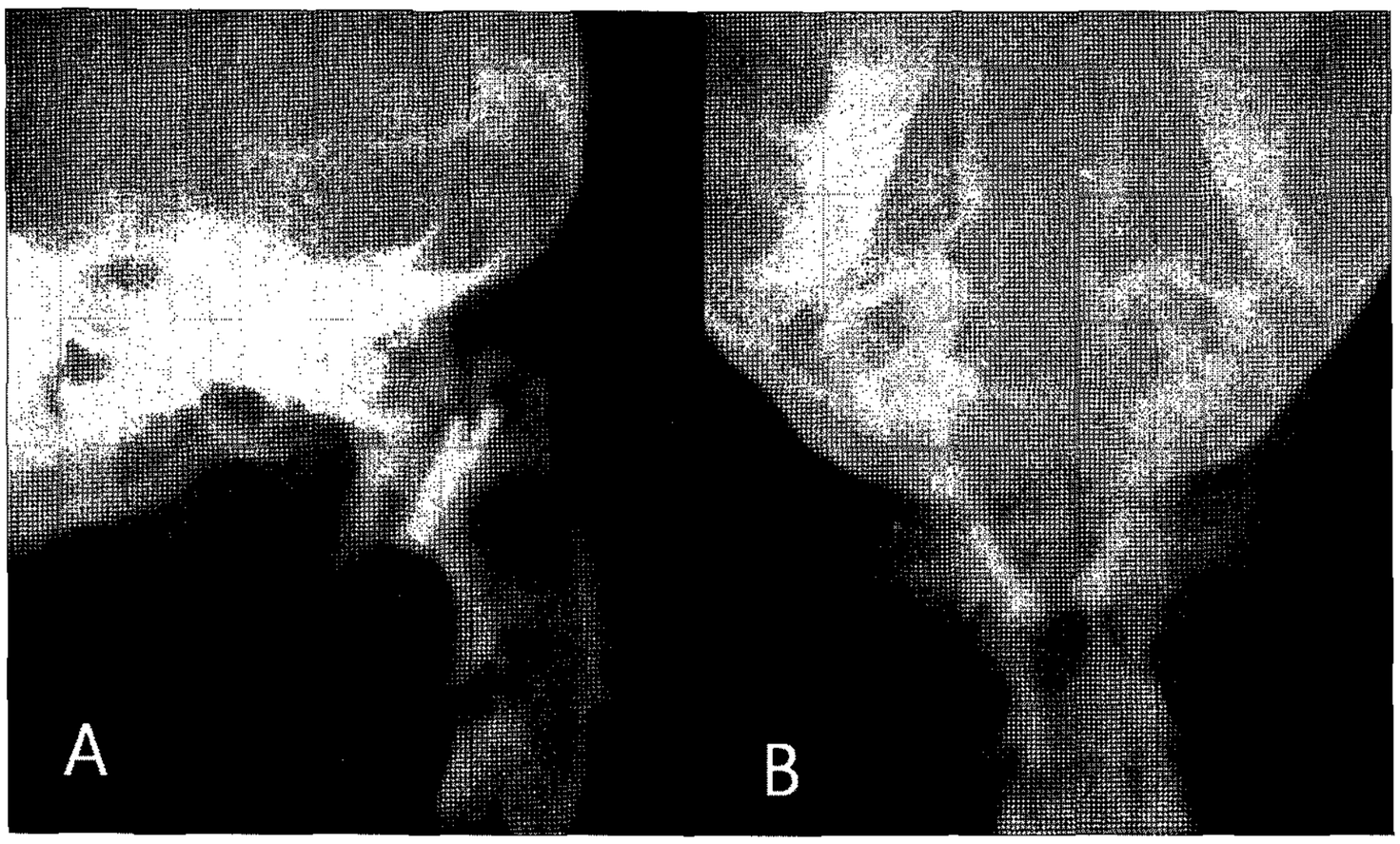

Fig 6. Postoperative (A) lateral and (B) ventrodorsal radiographs of a dog after fixation of the AA joint with screws.

and no migration of screws (Fig 6). At follow-up evaluation obtained by telephone at 4 month postoperatively, the owner reported that the dog showed complete resolution of clinical signs and that there was no signs of recurrence. We were not able to keep track of this dog since then.

Discussion

Surgical correction of AA subluxation is indicated in cases that show central nervous system problems (5,6,12). The purposes of surgery are to eliminate compression on the spinal cord and to immobilize the atlantoaxial joint (6,12,10). Surgical techniques for AA instability to stabilize the atlantoaxial joint include both dorsal and ventral stabilization using wire fixation (1,6,15), cross-pin fixation (4,8,9,11), screws (6,9,12), the nuchal ligament (5) and ventral implants (6,11).

Ventral approaches to the AA joint provide access to the articular surfaces for removal of articular cartilage, allow transarticular placement of pins or screws, and promote a bony fusion. Advantages of the dorsal procedure include ease of approach and good exposure of the dorsal aspects of the atlas and axis. A disadvantage of the dorsal approach is that there is no access to the articular surface of the AA joint, thus the atlas and axis cannot be permanently fused (1). The veterinary literature revealed that dorsal techniques resulted in fixation failure rates of 37~38% and the mortality rates of 16~29% of all reported cases (6,7), whereas in ventral techniques fixation failure rates were 29% and the mortality rates were 8~19% (4,6,9,11). When the results of screw transarticular fixation are composed with smooth pin fixation, screw fixation is much better than smooth pins (4,7).

The failures reported after dorsal wire fixation included suture breakage, 'cheese-wire' of C2 spinous process and wire suture breakage (13,15). Complications associated with stabilization using pins are improper pin placement and pin migration (14). Use of transarticular screw fixation or using PMMA(polymethylmethacrylate) around the pin tips decreased the incidence of these problems (11). Failure rates should be lower when screws or threaded pins are used instead of K wires (1, 12).

Failure of ventral fixation of AA subluxation was resulted from improper angulations of the transarticular pins or screws (14). The average mediolateral pin angle in dogs undergoing a successful stabilization was between 22° and 27°, and a practical range of 10° and 45°, and the average ventrodorsal angle was between 28.5° and 34.5°, and a practical range of 15° and 45° (6). Because we placed screws under fluoroscopic guidance, more proper angulations were provided. In this report, the mediolateral angles (left 29° and right 28°) and the ventrodorsal angles (left 35° and right 32°) were well within the ideal pin angles.

Neck brace was applied in the dog of this report. One reports described that a cervical brace was not placed after first surgery in 4/6 dogs that required a secondary surgery (1). Placement of an external brace after surgical stabilization of cervical vertebrae is commonly recommended (6,11,12). Though each surgical method has some failure rate, what is important is to maintain rigidity. In the present case, proper angulations of screws provided under fluoroscopic guidance, enabled adequate stabilization of the AA joints using ventral transarticular screw fixation which improved neurologic outcome of the patient.

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Ventral Fixation of Atlantoaxial Joint under Fluoroscopic Guidance Using Screws in a Chihuahua Dog

환축추 아탈구 견에서 투시기 유도를 통한 복측 나사 고정술

이재훈 · 양희택 · 양우종 · 정다정 · 강은희 · 엄기동* · 최치봉 · 장화석 · 김휘율[1]

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요 약 : 5연령의 치와와 견이 사지 부전마비를 평가하기 위해서 내원하였다. 내원 시에 보행이 불가능한 사지 부전마비와 목 부위 통증을 보였다. 방사선 상에서 환축추 아탈구와 C1 등쪽의 추궁과 C2의 가시돌기의 거리가 증가 된 소견을 보였다. 외과적 고정은 투시기 유도 하에서 복측 접근을 통하여 2개의 나사(screw)를 사용하여 실시하였으며, 외부 고정(neck brace)을 3주 동안 실시하였다. 수술 후 4주 후 임상증상이 개선되어 보행이 가능 하였으며, 방사선 상에서 고정을 유지하고 있었으며, 나사의 이주 소견은 없었다. 4개월 후에 임상증상이 완전히 회복되었다. 본 증례에서는 복측 나사 고정을 투시기 유도하에서 실시함으로, 나사의 적합한 각도로 위치 시킬 수 있었다.

주요어 : 환축추 아탈구, 복측 고정, 투시기 유도, 나사, 개.