Case Report

Accessory atlantoaxial ligament avulsion fracture of the axis: Are there any clinical implications?

ABSTRACT

Injuries to the craniocervical support structures are frequently observed in neurotrauma cases. Stability of this region is of vital importance. Literature has mainly focused on three major ligaments of the craniocervical junction: The tectorial membrane, the transverse ligament, and the alar ligaments. However, the accessory atlantoaxial ligament (ALL) also seems to be involved in craniocervical stability as shown in cadaveric specimens. Still, the biomechanical importance of this structure needs to be determined, especially in trauma settings. Here, we describe a case of isolated traumatic injury to this structure and discuss the clinical outcome. A 64-year-old polytrauma patient with a remarkable avulsion fracture at the site of the insertion of the ALL was admitted to our center. We evaluated the patient both clinical and radiological at admission, after 3 months and after 1 year. We clinically assessed the upper cervical rotational stability using the cervical flexion-rotation test. We observed no rotational instability or any other clinical repercussions at the long-term after an isolated ALL injury. This case shows that isolated traumatic damage to the ALL is possible. Unilateral damage to the ALL probably does not cause rotational instability of the craniocervical junction. In case a similar avulsion fracture is observed, we recommend performing a magnetic resonance imaging of the craniovertebral region to assess for any ligamentous lesions.

Key words: Avulsion fracture; craniocervical junction; ligament; trauma.

Introduction

The accessory atlantoaxial ligament (ALL), also referred to as accessory Atlantoepistrophic capsule, lateral extension of the tectorial membrane or "accessory atlantoaxial occipital ligament" is a 2.5–3.2 cm long and 5.0–6.0 mm wide band that runs from the back of the lateral mass of the atlas downward and medially to the back of the body of the axis.[1-4] By forming a halter for the odontoid ligament, it seems to play a role in rotational stability at the craniocervical junction. Recent anatomical studies have brought back the attention to this structure and detail the function of the ALL as a stabilizer.[3] However, the exact role and the significance of the function of this structure in relation to the stabilizers mentioned above remains unclear.

Case Report

A 64-year-old cyclist was transferred to our accidents and emergency department after being hit by a car. The vehicle had collided on his right side, and the man was rammed on the crash barrier (on the left hemithorax). There was no head trauma, and the patient was awake, alert and well oriented on a primary presentation at our center. Moreover, there were no neurological signs and symptoms. A spiral computed tomography (CT)-scan of the head, neck, thorax, and abdomen was performed at the referring hospital. This study revealed multiple crushed and displaced ribs, lung contusions bilaterally and a left-sided pneumothorax together

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Hamid Reza Niknejad, Frank van Calenbergh, Philippe Demaerel[1], Johannes van Loon

Departments of Neurosurgery and [1]Neuroradiology, University Hospitals Leuven, Herestraat 49, Leuven 3000, Belgium

Address for correspondence: Dr. Hamid Reza Niknejad, Department of Neurosurgery, University Hospitals Leuven, Herestraat 49, Leuven 3000, Belgium.
E-mail: hamidreza.niknejad@uzleuven.be

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with subcutaneous emphysema. Comminuted fractures of the left scapula and clavicle were observed. Furthermore, the abdomen showed a rupture of the diaphragm with herniation of the stomach, along with a rupture of the spleen. There were no cranial or cerebral injuries on imaging. Finally, a CT-scan of the cervical spine showed a remarkable fracture located paramedian at the posterior border of the axis, right under the base of the dens [Figure 1]. The site at which the bone cortex had broken off together with the direction of displacement led us to believe it concerned an avulsion fracture of the accessory ALL as illustrated in Figure 2.

The patient underwent thoracic surgery and was administered at the Intensive Care Unit to recover from his injuries. In this setting, we were able to perform a magnetic resonance imaging (MRI) of the cervical spine 6 weeks after the accident to inspect for any damage to the ligamentous structures [Figure 3].[1,2] This study showed no damage to the tectorial membrane [Figure 3a] or the transverse and alar ligaments [Figure 3b and c] on T2-weighted sagittal and axial images. The avulsion, on the other hand, was still visible on T1-weighted sagittal images [Figure 3d]. Finally, an enlarged epidural space was present at the site of the avulsion [Figure 3c].

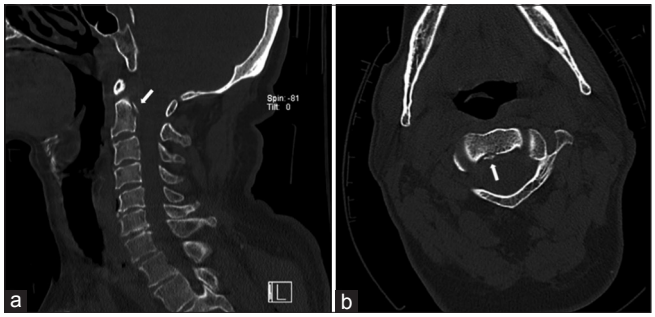

Figure 1: (a) Sagittal and (b) axial computed tomography of the cervical spine showing the avulsion fracture marked by the white arrow

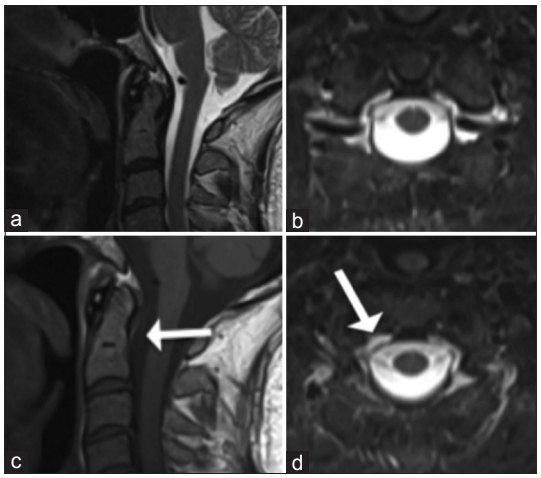

Figure 3: Magnetic resonance imaging studies of the craniocervical region. (a) Sagittal T2 weighted image shows no damage to the tectorial membrane. (b) T2-weighted axial images of the upper cervical spine showing an intact transverse ligament. (c) The avulsion, marked by an arrow is still visible on sagittal T1-weighted images. (d) T2-weighted axial images of the upper cervical spine showing intact alar ligaments, note the enlarged epidural space at the level of injury marked by the arrow

After 1 year follow-up, CT imaging showed healing of the fracture site without evidence of any existing atlantoaxial instability [Figure 4]. Electromyography showed normal and full relaxation of the semispinalis, splenius capitis, levator scapulae, sternocleidomastoid, and trapezius muscles. The patient had no limitation in the C1–C2 cervical range of motion as demonstrated by the cervical flexion-rotation test [Figure 5].

Discussion

The accessory ALL is a well-defined anatomical entity of the craniocervical region.[3,4] As stated by Tubbs and others these ligaments probably assist the alar ligaments in limiting primary craniocervical rotation. By limiting primary craniocervical rotation, it is assumed to significantly contribute to *in vivo* stability.[5] Excessive craniocervical rotation can give rise to clinical symptomatology including pain and cervical nystagmus.[6,7] The atlantoaxial rotation can be assessed

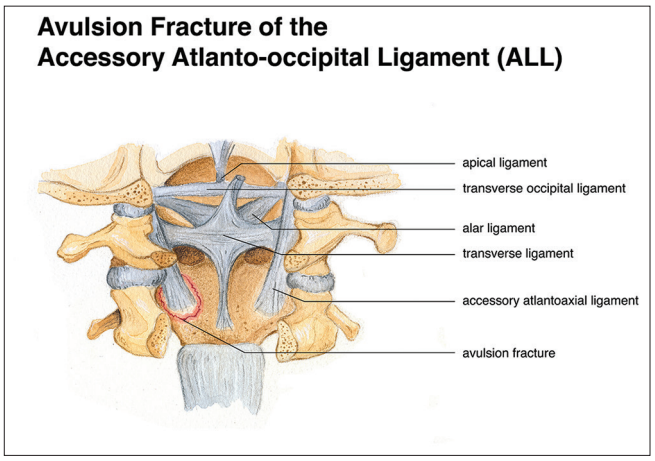

Figure 2: Artist's representation of an avulsion fracture of the atlantoaxial ligament. Posterior view on the craniocervical junction. The ligamentous structures are labeled with their names. The fracture site is enhanced. Copyright Niknejad *et al.* 2015

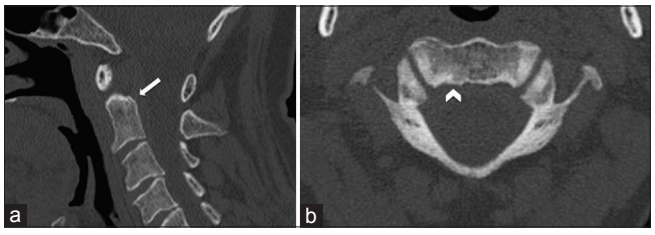

Figure 4: (a) Sagittal and (b) axial computed tomography of the cervical spine showing healing of the fracture site indicated by the white arrow

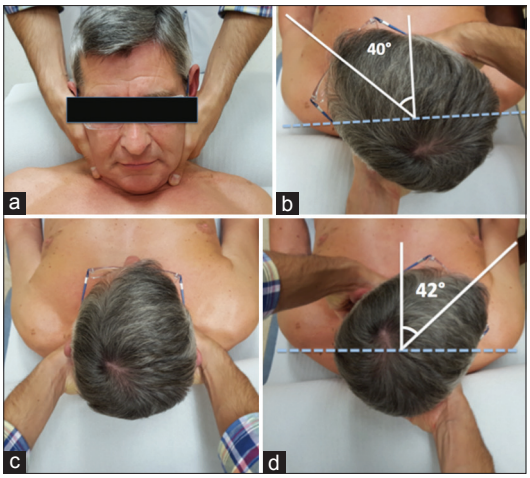

Figure 5: The cervical flexion-rotation test at 1 year follow-up. (a) Baseline position with the neck maximally flexed. (b) Range of rotation to the left, dashed line represents shoulder position. (c) Baseline position from above. (d) Range of rotation to the right, dashed line represents shoulder position

clinically with the cervical flexion-rotation test. In this test, the cervical spine is fully flexed, in an attempt to isolate movement to C1–C2, which has a unique ability to rotate in flexion. The normal range of rotation in end range flexion has been shown to be 44° to each side.[8] The current case is the first report of an avulsion fracture of the AAL in literature. We have found no clinical repercussions of this traumatic injury. The patient was questioned and examined 6 weeks, 3 months, and 1 year after the accident and he had not developed any signs or complaints related to the avulsion fracture. Rotational manipulations of the neck, in particular, caused no pain. Based on the CT-images, we were unable to evaluate the integrity of the ligamentous structures. Because of the necessity of intensive care treatment we performed a relatively late MRI scan. This study showed no damage to the main ligamentous structures. It did show a hyperintensity in the region of the tectorial membrane on the right side together with an enlarged epidural space [Figure 3]. The tectorial membrane, which lies over the ALL and is quite adherent to it, had remained intact. This ascertainment together with findings on CT and MRI may support our diagnosis of an isolated ALL injury. Yuksel *et al*. demonstrated the ALL can be reproducibly visualized with 3-T MRI scanning.[4] In this perspective, it seems reasonable to assess the integrity of the ALL in trauma setting along with an evaluation of other structures of the craniocervical junction.[9] This case shows that isolated traumatic damage to the ALL is possible. Given the clinical course of our patient, this report illustrates that perhaps unilateral damage to the ALL does not cause rotational instability of the craniocervical junction. Despite the fact no damage of the main ligamentous structures was found in our case, we still would advise to perform an MRI of the craniovertebral region when similar avulsion fracture is observed. To conclude we agree there is a need for future biomechanical studies to elucidate the importance of the ALL in trauma setting.

Declaration of patient consent

The authors certify that they have obtained all appropriate patient consent forms. In the form the patient(s) has/have given his/her/their consent for his/her/their images and other clinical information to be reported in the journal. The patients understand that their names and initials will not be published and due efforts will be made to conceal their identity, but anonymity cannot be guaranteed.

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Nil.

Conflicts of interest

There are no conflicts of interest.

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