

## Technical Note &amp; Surgical Technique

## Closed reduction of traumatic atlantoaxial rotatory subluxation with type II odontoid fracture



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## ABSTRACT

**Background:** Traumatic atlantoaxial rotatory subluxation (TAARS) in adults is rare. We present an uncommon case of traumatic atlantoaxial rotatory subluxation with an associated type II odontoid fracture in a neurologically intact patient and describe a novel technique used for a successful closed reduction.

**Case description:** A 20-year-old female presented with a decreased level of consciousness after being involved in a motor vehicle accident at highway speeds. A computed tomography (CT) demonstrated atlantoaxial rotatory subluxation and a type II odontoid fracture. CT angiography showed a left V3 vertebral dissection. She was neurologically intact on examination. A halo ring was applied and the patient successfully underwent closed reduction using traction and a novel transoral reduction technique described below.

After closed reduction, a C1–C2 posterior instrumented fusion was performed. At 12-weeks follow-up, the patient was asymptomatic, neurologically intact with optimally maintained cervical spine alignment.

**Conclusion:** Prompt manual closed reduction can safely be achieved in adults using this novel transoral reduction technique, which we describe for the first time in this report.

## 1. Introduction

Traumatic atlantoaxial rotatory subluxation (TAARS) is uncommon in adults. Even more uncommon is TAARS combined with an odontoid fracture with only a few cases reported in the literature [1–7]. This injury pattern usually arises from a high-energy mechanism and hence has the potential to be extremely unstable and cause neurological compromise. We demonstrate with this report for the first time how early closed reduction can be safely achieved using a novel transoral approach and fluoroscopy.

## 2. Case report

A previously healthy 20-year-old female sustained a mild closed head injury and an atlantoaxial rotatory subluxation with a type II odontoid fracture following a head-on motor vehicle collision with another vehicle at highway speed. Her Glasgow Coma Scale (GCS) on scene was 5, hence she was intubated and air lifted to our facility. She remained hemodynamically stable in transit and her GCS improved to a 7T (E1, VT, M5) upon arrival in the trauma bay.

On examination, she had a small facial abrasion and no other external signs of trauma. Her cervical spine was immobilised in a hard collar but her head was rotated towards the right. Her pupils were equal

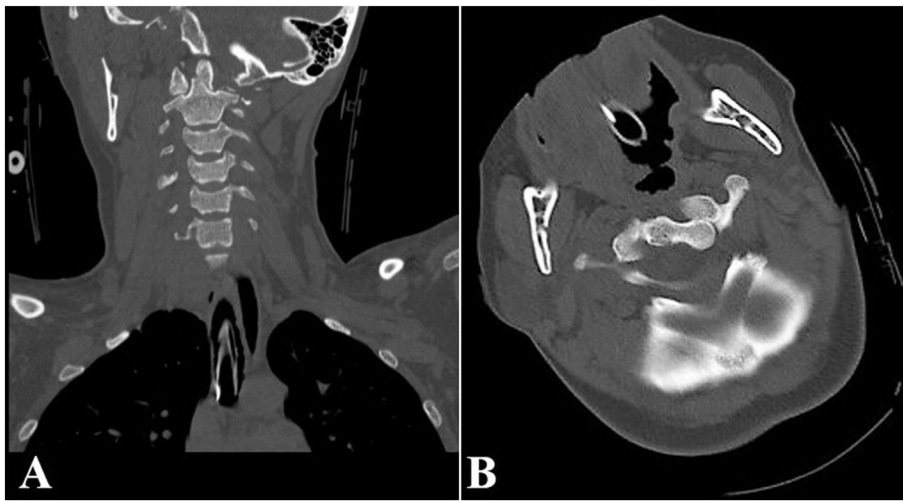
and reactive and she localised to central pain stimulus. Muscle tone and reflexes were normal with a negative Babinski pathological reflex. CT of the brain and c-spine revealed: i) no evidence of structural injury to the brain, ii) a type II odontoid fracture (Fig. 1a), and iii) the left C1 lateral mass was anteriorly rotated and displaced inferiorly relative to C2 with posterior subluxation of the right C1 and C2 lateral masses (Fig. 1b). She was taken to the Intensive Care Unit (ICU) for hemodynamic monitoring and physiologic support.

## 3. Technical note (manual reduction technique and stabilization)

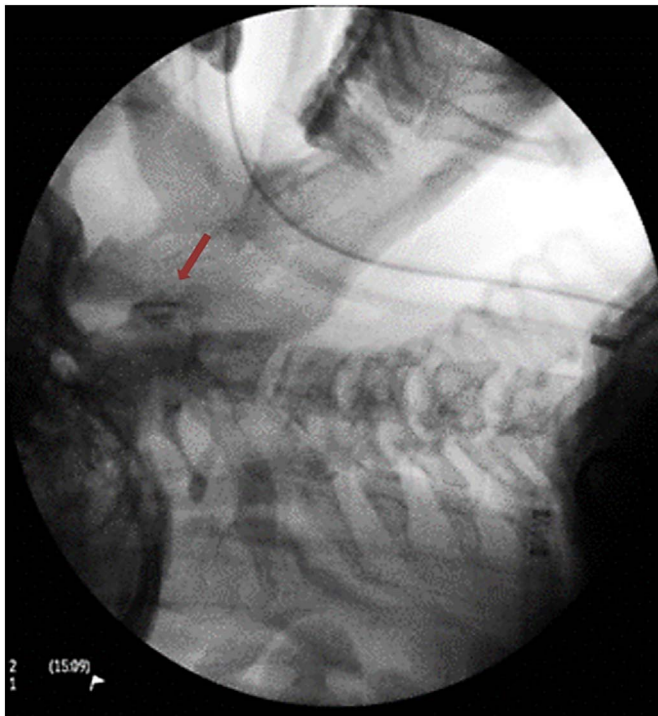
A halo ring was applied under general anesthesia. The head of the bed was elevated to provide counter traction and the shoulders fixed to prevent motion. Under fluoroscopic guidance, closed reduction was successfully performed as described below:

- i) with the halo ring, the lead surgeon (SdP) applied firm skull traction in the cephalad direction along with a gentle left (opposite side of rotational deformity) rotatory maneuver. No movement of the atlanto-occipital joint was noted on fluoroscopy.
- ii) simultaneously, an assistant physician used the index finger to apply force to the dislocated C1 lateral mass in counter rotation to the dislocation along the posterior pharyngeal wall (Fig. 2).

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**Fig. 1.** CT of the cervical spine. *a* Coronal views showing a type II odontoid fracture with the odontoid process minimally displaced anteriorly and to the left. *b* Axial view showing anterior rotatory dislocation of the left lateral mass of C1 relative to C2.



**Fig. 2.** Lateral x-ray of the c-spine. Red arrow illustrates an assistant's finger in the oropharynx pressing against the dislocated lateral mass. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

- iii) a “clunk” sound was felt once the atlantoaxial joint was reduced and this was confirmed on fluoroscopy.
- iv) steps involved in this technique are illustrated in [Fig. 3](#).

The patient was neurologically intact on examination after closed reduction and underwent further diagnostic imaging shortly after. CTA confirmed normal atlantoaxial alignment and a distal left V3 vertebral artery dissection ([Fig. 4](#)). MR c-spine showed no spinal cord or ligamentous injury ([Fig. 5a](#)). She was taken to the operating room for a C1–C2 posterior instrumented fusion. The patient was positioned prone with halo fixation attached to the table. A standard posterior midline approach and subperiosteal dissection was performed. Under fluoroscopy lateral mass screws were placed in the C1 lateral masses and pars screws placed in C2 lateral masses. A connecting rod was inserted and locked to the screw heads to stabilise the C1–C2 complex.

Post operatively, she remained neurologically intact. She was treated with Acetylsalicylic acid (ASA) for the left vertebral artery dissection. At the 1-year follow-up, she was asymptomatic with an optimally maintained reduction and a stable fixation ([Fig. 5b](#)).

#### 4. Discussion

Traumatic atlantoaxial rotatory subluxations (TAARS) also referred to in the literature as rotational subluxation, rotatory dislocation, rotatory displacement, rotatory deformity, rotatory fixation or spontaneous hyperemic dislocation are a rare entity in adults [8–10]. Atlantoaxial rotatory subluxation typically occurs in the pediatric population due to ligamentous laxity which allows for subluxation. Causes such as congenital abnormalities (e.g. Down's and Marfan's syndrome), infection (e.g. Grisel's syndrome, eosinophilic granuloma), inflammation (rheumatoid arthritis) and neoplasm have all been described [11–14]. Although combined injuries of the upper cervical spine have been documented [15], TAARS combined with type II odontoid fractures are extremely rare. Our search through the English literature yielded only seven such cases previously reported ([Table 1](#)). Our patient had a type II rotatory subluxation based on the Fielding and Hawkins classification [8].

Management of TAARS is controversial but generally requires reduction followed by internal or external immobilisation. Type II odontoid fractures are usually treated with surgical fixation either via an anterior approach using an odontoid screw or posterior approach using C1–C2 transarticular screws or C1 lateral mass and C2 pars screws. Conservative treatment with immobilisation has been reported in patients who are stable and anatomically reduced. Traction with successful reduction followed by external immobilisation for 6–12 weeks has shown good long-term rotational stability [16–18]. In our case we were able to achieve closed reduction by performing skull traction, rotatory unlocking and counter rotating maneuver and transoral displacement of the subluxed C1 lateral mass using finger pressure along the posterior pharyngeal wall. The left C1 lateral mass was rotated and displaced inferiorly locking it behind the C2 lateral mass. Our technique helps unlock the lateral mass while traction and rotation completed the reduction. Early closed reduction is important in decompressing neural elements. Successful closed reduction makes it possible to treat patients conservatively with immobilisation device in a timely manner. In the case of the patient presented in this report, instrumented fusion was performed due to suspicion of noncompliance if she was treated with external immobilisation alone. Length of time from injury to reduction may correlate with recurrence rate and failure of conservative treatment [19]. Our technique like other closed reduction maneuvers can potentially cause neurological injury or even

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