

Transoral Closed Reduction of Fixed Atlanto-Axial Rotatory-Subluxation (AARS) in Childhood and Adolescence

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Abstract: Atlanto-axial rotatory-subluxation (AARS) is the most common pediatric cervical spine injury. Patients usually present with contralateral rotation and inclination of the upper cervical spine after minor trauma, or associated with an infection of the upper respiratory tract. According to the authors, initial management of patients with acute and chronic AARS type I–II should comprise closed reduction and immobilization with a cervical collar or a Halo-Body-Jacket. Surgical options of open reduction or C1/2 fusion should be restricted to irreducible or recurrent subluxations. This paper reviews the detailed technique of transoral closed reduction of AARS, as well as the preoperative and postoperative considerations.

Key Words: atlanto-axial rotatory-subluxation, atlanto-axial rotatory-fixation, closed reduction, pediatric cervical spine injury, Grisel's syndrome

(*Clin Spine Surg* 2018;31:E252–E256)

Atlanto-axial rotatory-subluxation (AARS) is the most common pediatric cervical spine injury,^{1–7} and can be classified according to Fielding and Hawkins assessing the direction and extent of atlas rotation (Fig. 1).² Patients usually present with contralateral rotation and inclination of the upper cervical spine after minor trauma, or associated with an infection of the upper respiratory tract Grisel's syndrome. According to the authors, initial management of patients with acute AARS type I–II should

comprise closed reduction and immobilization with a cervical collar. AARS type I is a rotation of C1 with unilateral facet subluxation with intact transverse ligament. The center of rotation is located in the odontoid. Type II injury represents a unilateral facet subluxation with an atlantodental interval of 3–5 mm, and is associated with transverse ligament injury. Type III injuries represent unilateral facet subluxations with an atlantodental interval of > 5 mm. In type II and III injuries, the center of rotation is located in the contralateral facet joint. AARS type IV injuries comprise a posterior dislocation of C1, which can be associated with an odontoid fracture or aplasia.²

The authors recommend plain radiographs including anteroposterior and lateral views (Figs. 2A, B) of the cervical spine as well as an open-mouth odontoid view (Fig. 3) at primary presentation if AARS is suspected. In most cases, AARS can be diagnosed when the facet joint is covered by the lateral mass of C1 in the odontoid view, or the lateral mass is projected anteriorly to the odontoid process on the lateral view. If AARS is suspected, CT images with 3D reconstruction will demonstrate the direction and extent of atlas rotation, and are essential to classify the injury (Figs. 4A–C). Magnetic resonance imaging of the cervical spine provides soft tissue detail with special regard to disruption of the transverse ligament.

INDICATIONS

- Acute AARS type I–II
- Chronic AARS type I–II (> 6 wk)

CONTRAINDICATIONS

- AARS type IV

SETUP

Instruments and Materials Required

General anesthesia
Endotracheal intubation
Hard cervical collar or
Halo-Body-Jacket
Fluoroscopy

Positioning

The patient is placed supine on a radiolucent table without any head support. If the patient has significant impairment of neck extension and mouth opening, an

Received for publication December 15, 2016; accepted May 23, 2017.
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The authors declare no conflict of interest.

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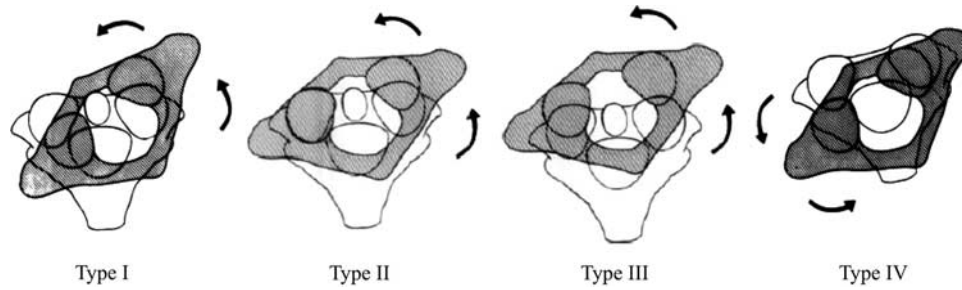


FIGURE 1. Atlanto-axial rotatory-subluxation classified according to Fielding and Hawkins.²

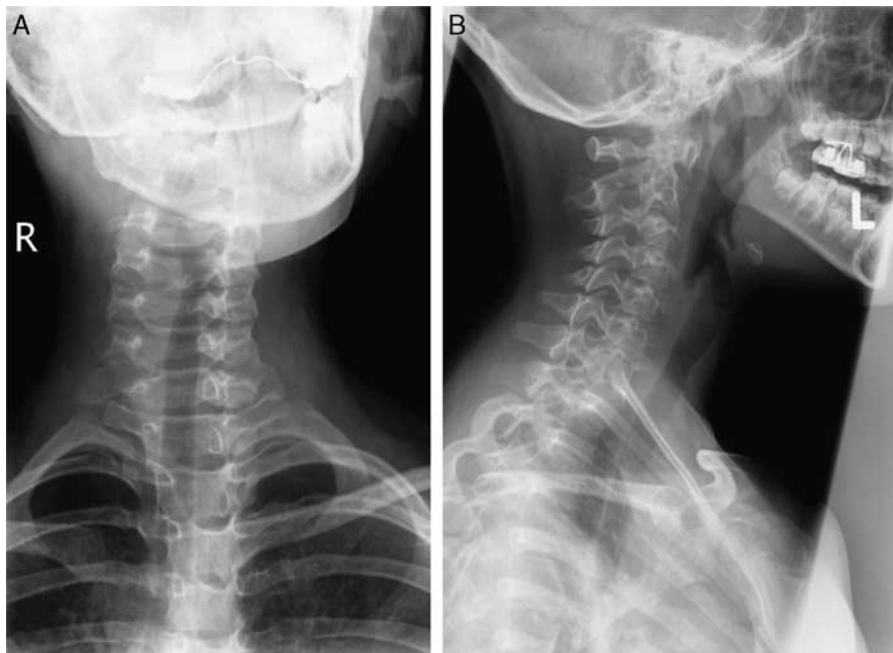


FIGURE 2. Anteroposterior (A) and lateral view (B) of the cervical spine demonstrating “cock-robin” deformity with contralateral rotation and inclination of the upper cervical spine of a right-sided atlanto-axial rotatory-subluxation.



FIGURE 3. Open-mouth odontoid view demonstrating a right-sided atlanto-axial rotatory-subluxation with a right-sided covered facet joint by the lateral mass of C1.

awake fiber-optic intubation should be considered. The patient’s arms are placed at his sides. In case of chronic AARS, a halo-ring is applied with 4 pins (2 × frontal, 2 × supra-auricular) before the maneuver to be able to apply more traction during the reduction maneuver.

REDUCTION TECHNIQUE

After induction of general anesthesia, endotracheal intubation is performed. The oral cavity is opened and folded pads are placed over the incisors of the upper and lower jaw to protect the manipulating fingers of the surgeon. See Supplement Digital Content 1 (Video), <http://links.lww.com/CLINSPINE/A36> for more information.

Step 1: Fixation of C2 Spinous Process

The spinous process of C2 is palpated and locked between index finger and thumb of the adominant hand (Fig. 5).

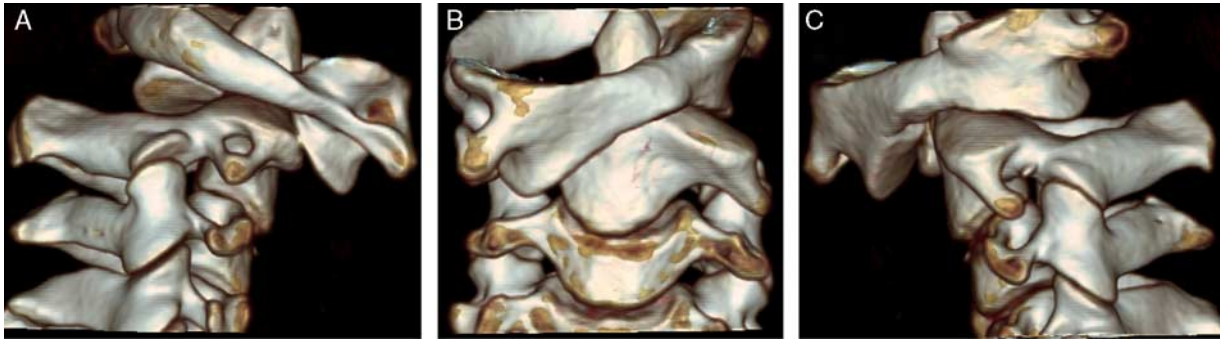


FIGURE 4. Computed tomographic images with 3D reconstruction demonstrating a right-sided atlanto-axial rotatory-subluxation type I according to Fielding and Hawkins with views from the right (A), front (B), and left (C).



FIGURE 5. Fixation of C2 spinous process.

Step 2: Palpation of C1 Subluxated Lateral Mass in the Nasopharynx and Reduction

The mouth is opened with the dominant hand (Fig. 6A), and the anterior tubercle of the atlas is palpated

with the dominant hand index finger. The subluxated lateral mass of C1 can be palpated in the posterior wall of the throat on the side of the luxation (Fig. 6B). Traction can be applied by both hands, while the index finger of the dominant hand applies direct pressure to the subluxated lateral mass of C1 transorally, and counter rotation to the dislocation is applied (Fig. 7). A slight “clicking” sensation by the index finger may indicate a successful reduction. The reduced lateral mass of C1 cannot be palpated anymore through the posterior wall of the pharynx.

Step 3: Atlanto-Axial Mobilization and Fluoroscopy

After reduction, maximal rotatory movements of the head to the right and left are performed under continuous pressure on the previously subluxated lateral mass of C1, starting with counter rotation to the side of the dislocation (Fig. 8A). Using fluoroscopy, an anteroposterior and lateral view of the cervical spine with the mouth wide open are conducted to document successful reduction (Fig. 9). A hard cervical collar is adjusted in acute AARS, and a Halo-Body-Jacket in chronic AARS

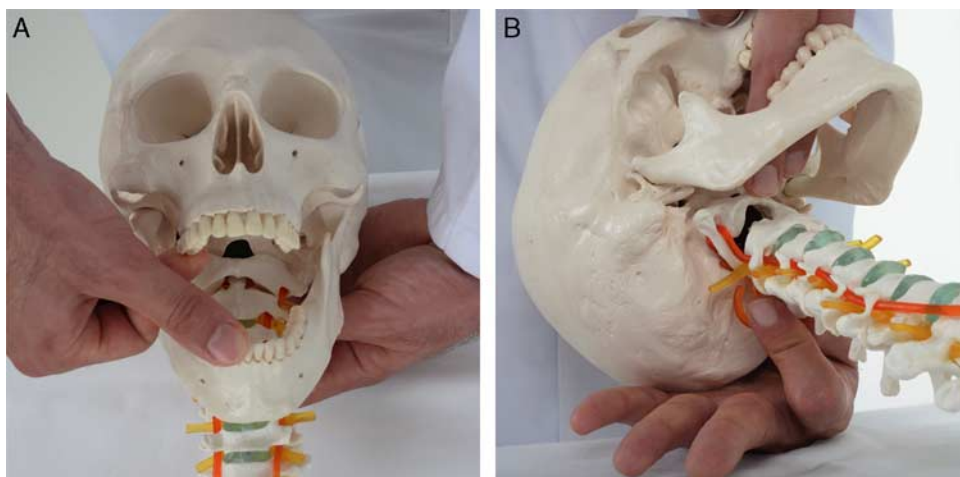


FIGURE 6. The mouth is opened (A) and the right-sided subluxated lateral mass of C1 in the posterior wall of the throat can be palpated (B).



FIGURE 7. The subluxated lateral mass of C1 in the posterior wall of the throat can be palpated with the dominant hand index finger. Traction of the head can be controlled by the intraorally placed dominant hand. Traction can be applied by both hands.

before the patient wakes up. In case of loss of reduction, the authors recommend to conduct the maneuver again.

POSTREDUCTION PROTOCOL

After successful reduction, patients undergo computed tomographic images of the cervical spine with 3D reconstruction to confirm the reduction. Patients are typically discharged home after successful mobilization.



FIGURE 9. Open-mouth odontoid view demonstrating successful reduction.

The authors recommend patients to increase activity as tolerated without high-impact activities in a hard cervical collar for 4–6 weeks in acute AARS or in a Halo-Body-Jacket for 12 weeks in chronic AARS. Surgical options, like open reduction or C1/2 fusion are reserved for situations in which the reduction maneuver fails, or after loss of reduction despite Halo-Body-Jacket immobilization.

PEARLS AND PITFALLS

During the reduction maneuver, the treating surgeon should watch his/her dominant hand fingers carefully, due to the risk of injury at the incisors of the upper and lower jaw. After reduction, patients might complain about pain swallowing caused by the manipulation in the back of their throat. Care should be taken after the reduction to exclude redislocation in the course of follow-up with plain radiographs including anteroposterior and lateral views of the cervical spine as well as an open-mouth odontoid view at 1, 2, and 4 weeks after reduction.

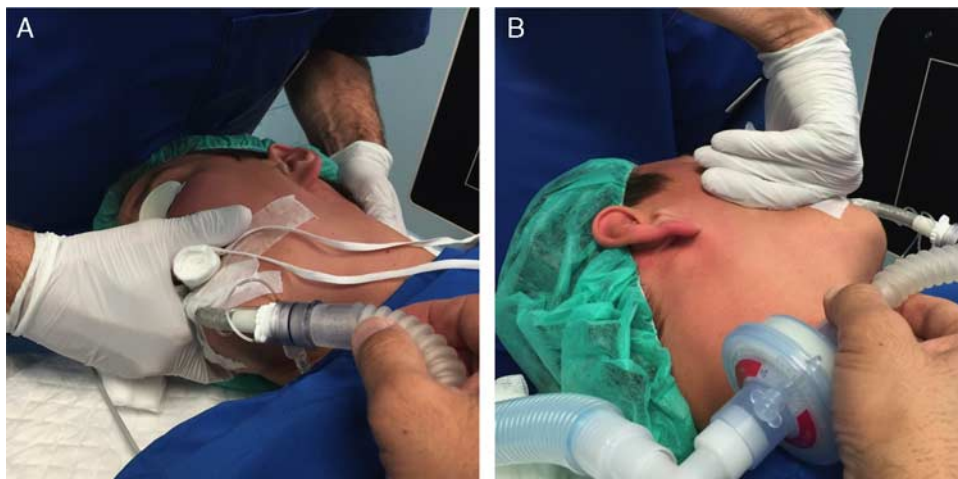


FIGURE 8. Mobilization of the head to the right (A) and left (B) under continuous pressure on the previously subluxated lateral mass of C1.

ACKNOWLEDGMENT

The authors thank Andreas Lütcher for advice and support with image and video production.

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