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Clinical Case Studies

Acute traumatic lateral atlantoaxial dislocation associated with locked atlas lateral mass and odontoid process fracture: A clinical case study and literature review

Wongthawat Liawrungrueang [a], Anupong Laohapoonrungsee [b], Torphong Bunmaprasert [b,*]

[a] Department of Orthopaedics, School of Medicine, University of Phayao, Phayao, Thailand
[b] Department of Orthopaedics, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand

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ABSTRACT

Background: Traumatic atlantoaxial dislocation combined with locked atlas lateral mass and odontoid process fracture is a complex injury and is extremely rare. We describe the surgical technique by presenting a clinical case study in managing a traumatic lateral atlantoaxial dislocation combined with a locked atlas lateral mass and a type II odontoid fracture (Grauer type IIB).

Case description: This is a clinical case study of a 38-year-old female patient who presented with severe neck pain without neurological deficit following a traffic accident. Computed tomography showed a type IIB odontoid fracture and a lateral C1-C2 dislocation with a laterally locked left lateral mass at the C1-C2 level. Emergency management included protecting the cervical spine and applying gradually increasing skull traction. The locked lateral mass and laterally-dislocated C1-C2 facet joints were partially reduced. An intraoperative joint reduction operation with leverage technique was then performed. Posterior C1-C2 fixation (a modified Harms-Goel technique) and fusion with iliac bone graft were then executed.

Outcome: Postoperatively, neck pain improved significantly. The atlantoaxial joint was successfully reduced and stabilized. Solid bony fusion was confirmed by a radiographic study at the 1-year follow-up.

Conclusions: Based on a review of current literature, traumatic lateral atlantoaxial dislocation combined with a locked atlas lateral mass and type IIB odontoid fracture is rarely seen. It is an extremely unstable injury. Our proposed leverage technique used in conjunction with a modified Harms-Goel technique is an effective alternative treatment. This approach can assist surgeons in the management of these difficult cases.

Background

Upper cervical spine injury is often associated with high-energy trauma in adults. Motor vehicle accidents (MVA) are the most common cause [1]. Atlantoaxial joint dislocation is a severe injury and is associated with a high mortality rate [1,2]. Traumatic atlantoaxial dislocation combined with a locked atlas lateral mass and an odontoid process fracture is a complex injury which is extremely rare among upper cervical injuries [3]. There have been few reports published and no agreement has yet been established on the method of determination of the level of severity or on the appropriate management of this injury [3,4]. This study reports on a success surgical outcome and presents a clinical case study from our experience in managing a traumatic lateral atlantoaxial dislocation combined with locked atlas lateral mass and type II odontoid fracture. This work has been reported in accordance with SCARE criteria [5].

Case description

A 38-year-old female presented with acute severe posterior neck pain one hour after an MVA. She had received advanced trauma life support protocol. When she awoke following that treatment, her hemodynamic status was stable. She did not smoke, consume alcohol, or use recreational drugs and no history of surgery or medical allergies. Physical examination revealed no abnormalities other than upper cervical soreness. Neurological assessment was completely normal. Cervical computed tomography (CT) scans in coronal (Fig. 1A-C), axial (Fig. 1D-F) and sagittal views (Fig. 2A-D) revealed a left lateral atlanto-axial dislo-

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* Corresponding author at: Department of Orthopaedics, Faculty of Medicine, Chiang Mai University, Chiang Mai, Thailand.
E-mail addresses: mint11871@hotmail.com (W. Liawrungrueang), anupong.l@cmu.ac.th (A. Laohapoonrungsee), torpong197@gmail.com (T. Bunmaprasert).

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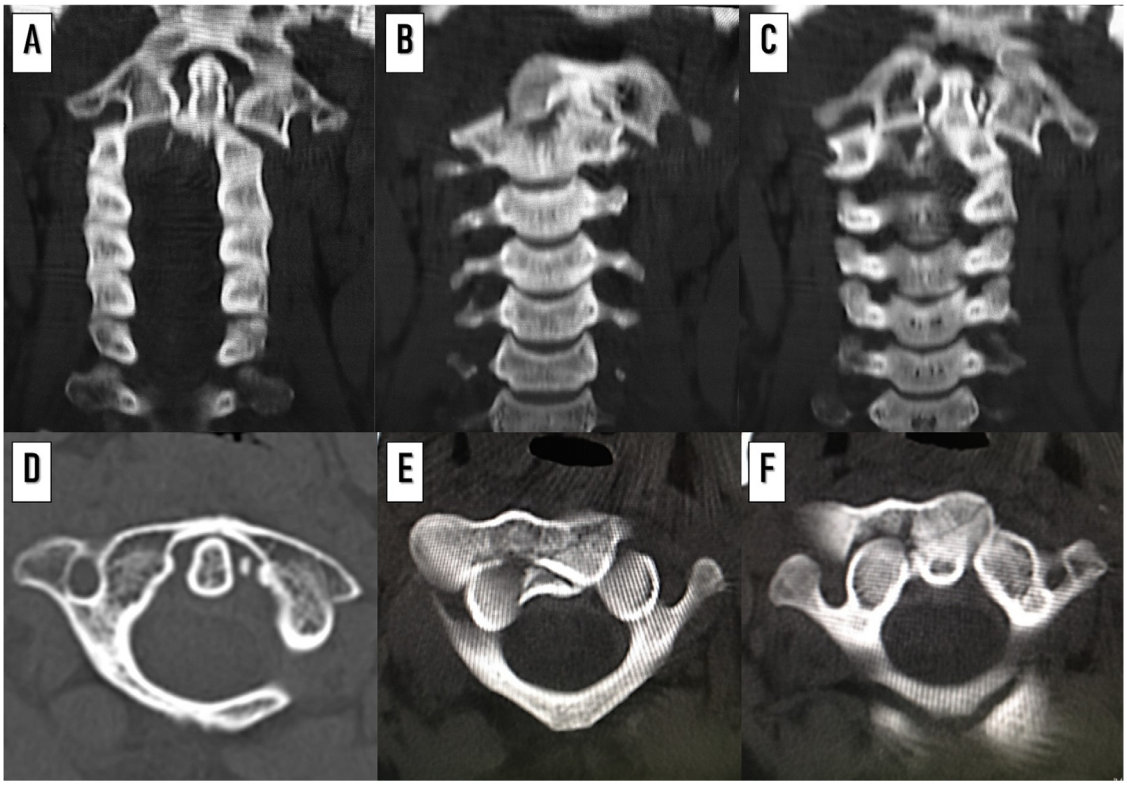

Fig. 1. CT scan showing a left lateral atlanto-axial dislocation associated with a type II odontoid fracture with a laterally locked left lateral mass at the C1-C2 level in coronal (A-C), and axial (D-F) views.

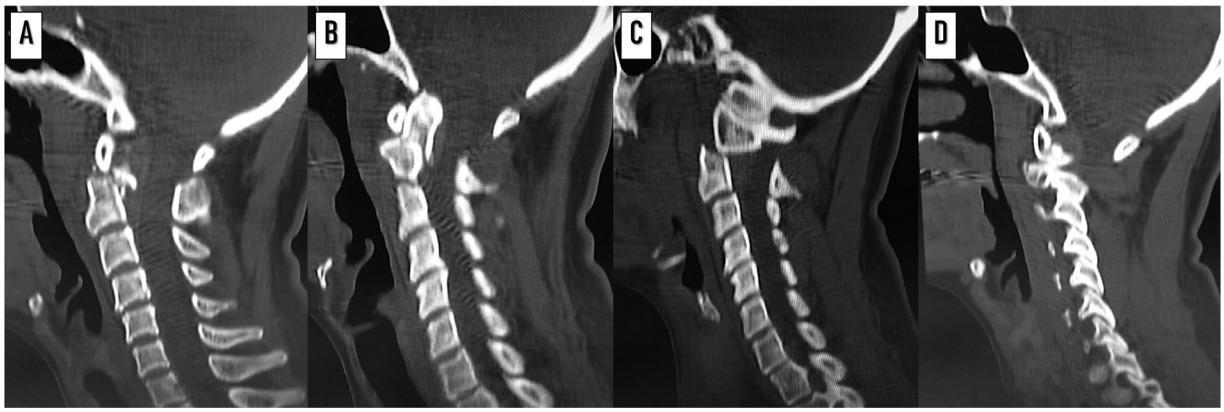

Fig. 2. CT sagittal images showing atlanto-axial dislocation associated with a type IIB odontoid fracture (A-D).

cation associated with a type II odontoid fracture (Grauer type IIB) with laterally locked left lateral mass at the C1-C2 level.

Closed reduction by continuous traction of 10-20 lb. via Gardner-Wells tongs was applied to the patient under intravenous pain control. Reduction of lateral atlanto-axial dislocation was unsuccessful and was discontinued because the patient was unable to tolerate the progressive neck pain. Following the unsuccessful closed reduction, open reduction under general anesthesia with the “leverage technique” was chosen, to be followed by posterior C1-C2 fixation using screw and rod constructs.

Intraoperatively, the patient was positioned in the prone position and cervical alignment was maintained with 10 lb. of skull traction to facilitate a posterior surgical approach to the upper cervical spine (Fig. 3A-C). An intraoperative joint reduction with leverage technique was then performed on the patient. While gently retracting the C2 nerve roots downward, a small Love-Adson periosteal elevator was used to lever the C1-C2 joints through a direct reversal of the dislocation. Fluoroscopic guidance images seemed to show a complete reduction of the atlantoaxial joint dislocation (Fig. 3D-E). Posterior C1-C2 fixation by C1 lateral mass-C2 pedicle screw (a modified Harms-Goel technique) and fusion with the iliac bone graft were then executed (Fig. 3F-G). This model demonstrates the steps in the leverage technique used for carrying out the open reduction (Fig. 4).

Written informed consent was obtained from the patient prior to the operation. This study has been waived ethical approved for this clinical case study by the ethical committees in accordance with the declaration of Helsinki. All authors declare no conflict of interest in this report.

Outcome

CT-scans were made to ensure that the correct screw placement and reduction quality had been achieved. CT scans with coronal (Fig. 5A-B), sagittal (Fig. 5C-E) and axial imaging (Fig. 5F-H) revealed a successful open reduction with proper screw position. Postoperatively, the patient was immobilized with a semi-rigid orthosis and was entered

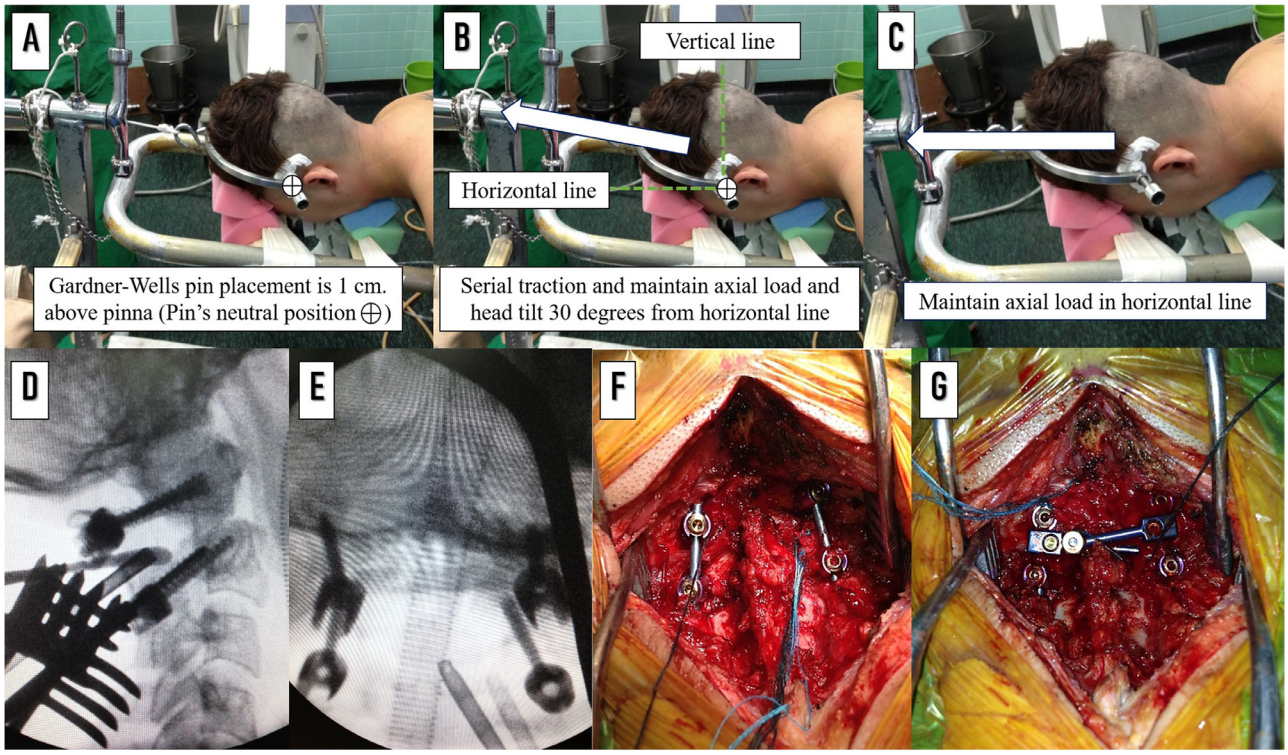

Fig. 3. Intraoperatively the patient was in the prone position and cervical alignment was maintained with 10 lb. skull traction for a posterior surgical approach to the upper cervical spine (A-C). Fluoroscopic images (D-E). Posterior C1-C2 fixation and fusion (F-G).

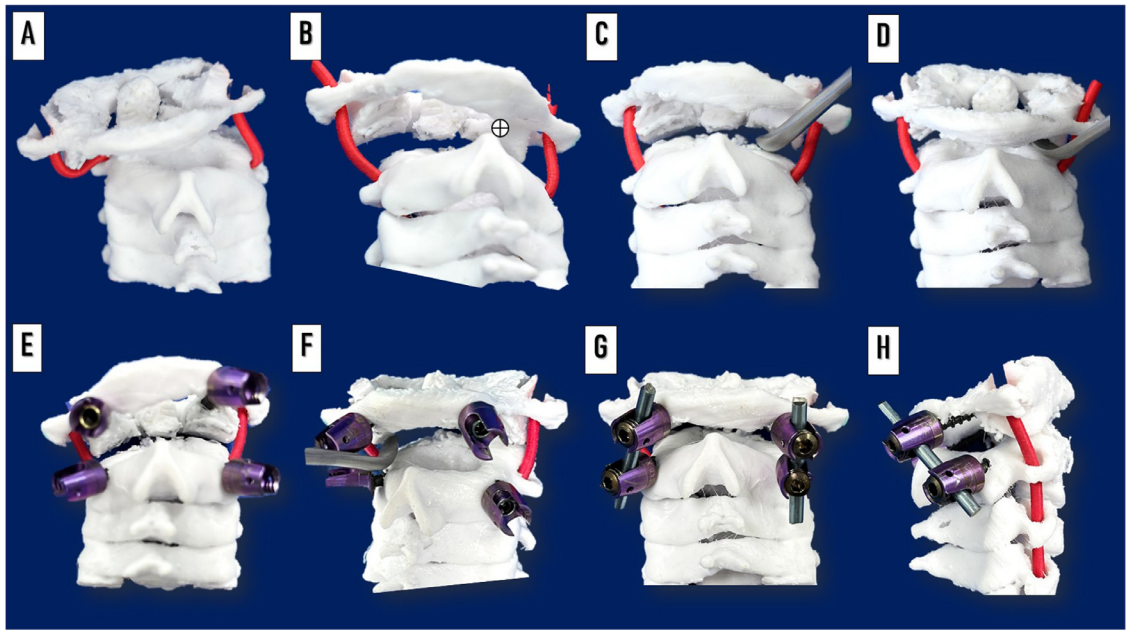

Fig. 4. A model demonstrating fracture-dislocation with laterally-locked C1-C2 facets (posterior view) (A), partial joint reduction using Gardner-Wells tongs and the reduction point (B), complete reduction by leverage technique using a Love-Adson periosteal elevator (C-D), posterior C1-C2 fixation by C1 lateral mass-C2 pedicle screws (E-H).

into a rehabilitation program. At the one-year follow-up, she had active asymptomatic cervical mobility with proper functioning. Follow-up radiographs confirmed that the cervical spine was in appropriate alignment and that solid bony fusion had been achieved (Fig. 6).

Discussion

Acute traumatic lateral dislocation of the atlanto-axial joint is uncommon. Odontoid process fractures are more frequent, accounting for 7-9% of traumatic cervical spine fractures [1,2]. Grauer et al.[1] presented a treatment-focused categorization of odontoid fractures. This classification divided odontoid fractures into three types (type I-III), with type II fractures separated into three subgroups (subclass IIA, IIB and IIC) [1]. A type II odontoid fracture is located at the base of the odontoid process where it joins to the body of C2 and it usually requires operative treatment [1,2]. A review of the literature over the past ten years found that acute adult traumatic atlantoaxial dislocation, either combined with or without locked atlas lateral mass, and type II odon-

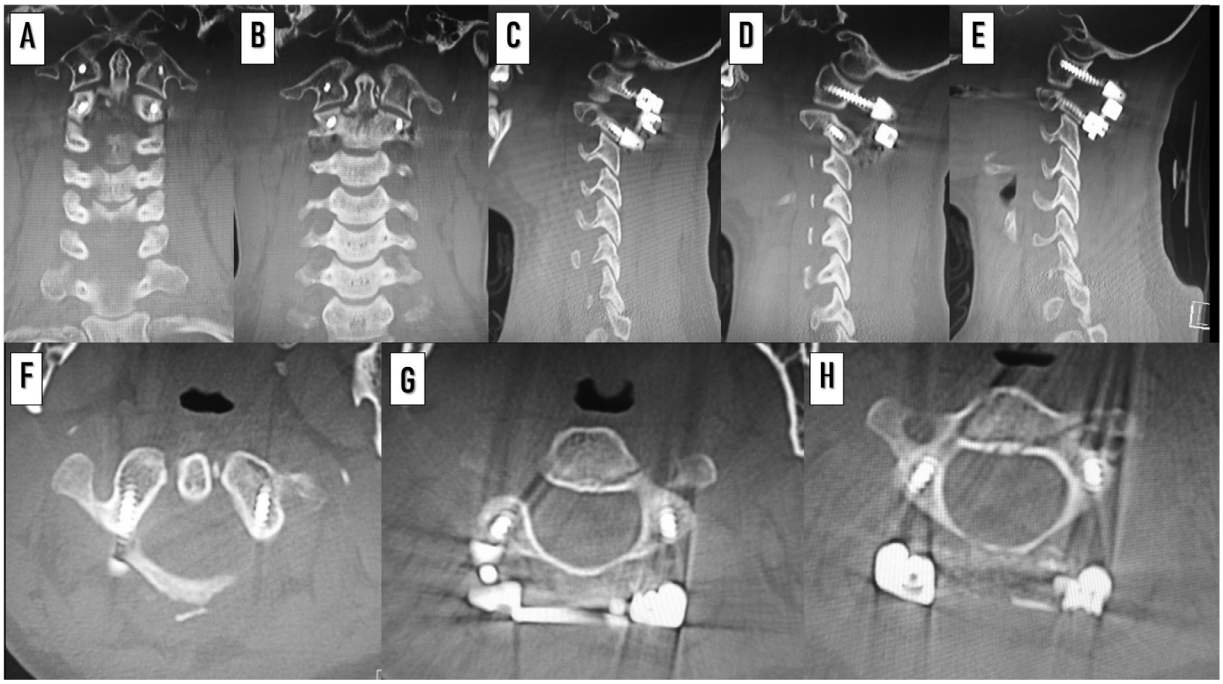

Fig. 5. Post-operative CT scan images: coronal (A-B), sagittal (C-E) and axial (F-H).

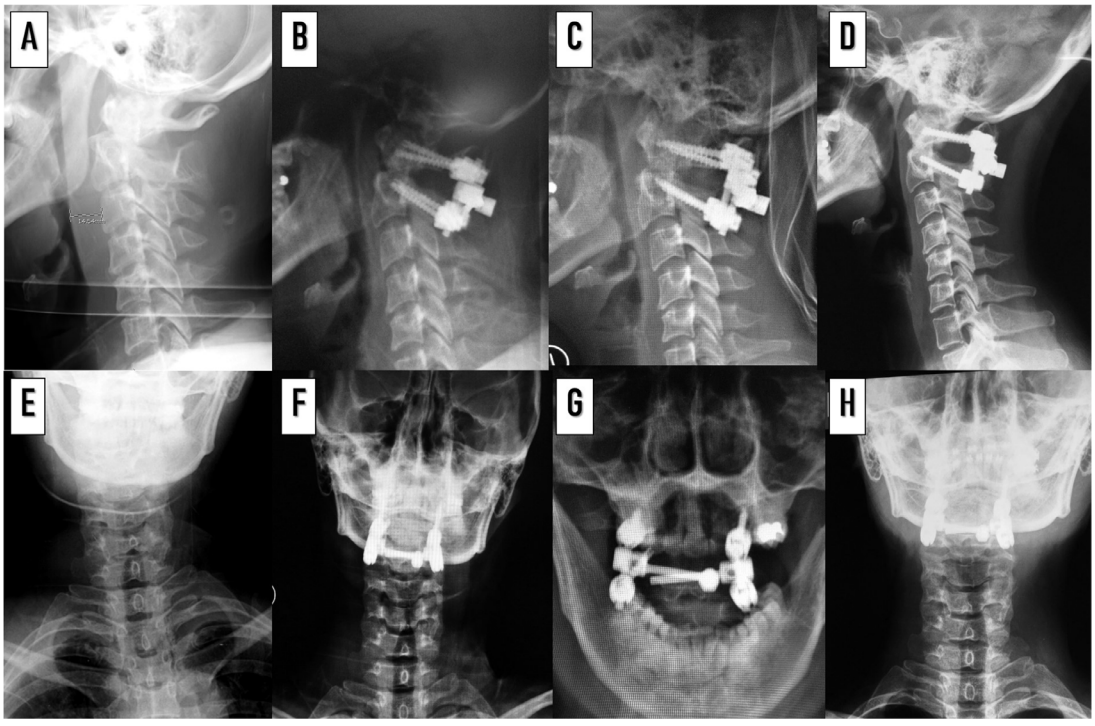

Fig. 6. Lateral radiographic images: preoperative (A), 1 month postoperative (B), 6 months postoperative (C) and 1 year postoperative (D). AP radiographic images: preoperative (E), 1 month postoperative (F), 6 months postoperative (G) and 1 year postoperative (H).

toid fractures treated with posterior C1C2 fixation and fusion are very rare (Table 1).

It is essential to be aware of the anatomical characteristics of an atlantoaxial joint dislocation. Five studies[3,4,6–8] each described a single case of atlanto-axial joint dislocation with lateral mass locking and odontoid fracture either with or without neurological deficit. All cases were treated successfully with continuous cervical traction and surgical intervention with posterior C1-C2 fixation and fusion, and all reported a successful clinical prognosis without comorbidities. Only one study, He et al.[3], reported that extending fixation to the C3 level (C1 to C3 fixation) was beneficial for stability and favorable outcome. In the present case, however, open reduction with leverage technique

Table 1
Reports of acute adult traumatic atlantoaxial dislocation either combined with or without locked atlas lateral mass and type II odontoid fracture treated with posterior C1-C2 fixation and fusion published between 2010 and 2020 in the English language.

Author (year)	Age (yrs)/Sex	Direction of dislocation	Pre-operative status	Symptoms	Reduction technique	Definitive operative procedure	Final clinical outcome	Complications/ notes	Follow-up
Lenehan et al. [6] (2010)	63/F	Lateral	Myelopathic with upper- and lower-limb hyperreflexia	Midline tenderness at the C1 and C2 levels	Closed reduction by continuous cervical traction with halo ring	Posterior C1 lateral mass screws and C2 pedicle screws fixation and fusion	Asymptomatic with complete resolution of myelopathic symptoms and signs	None	12 wk.
Clarke et al. [7] (2010)	80/M	Posterolateral	No neurologic deficits	Posterior cervical tenderness	Closed reduction with a halo jacket	Posterior C1-C2 fixation (screw and rod construct)	Complete fracture healing	None	none
Sullivan et al[8] (2013)	82/F	Posterolateral	Occluded left vertebral artery without neurologic deficits	Forehead ecchymosis and posterior cervical tenderness	Closed reduction with cervical traction with 30 lbs.	Posterior stabilization with a screw and rod construct from C1 to C2	Complete return of flow left vertebral artery with fracture healing	None	6 mo.
He et al. [3] (2016)	72/M	Posterlateral (locked lateral mass)	Bilateral upper extremity superficial hypoesthesia with limb muscle strength grade V	Neck pain and impaired movement	Closed reduction w/ Gardner–Wells tongs with continuous traction	Posterior C1 to C3 fixation (screw and rod) and C1-C2 posterior bone graft fusion	Complete fracture healing	None	12 mo.
Minyu et al. [4] (2018)	30/M	Posterolateral (locked lateral mass)	No neurologic deficits	Stiff head posture with decreased neck motion	Closed reduction w/ continuous skull traction	Posterior C1-C2 fixation (screw and rod)	Complete fracture healing	None	60 mo.
This case (2022)	38/F	Lateral (locked lateral mass)	No neurologic deficits	Posterior cervical pain	Gardner-Wells tongs traction and open reduction w/ leverage technique	Posterior C1-C2 fixation (screw and rod)	Complete fracture healing	None	60 mo.

under general anesthesia was used because the patient was unable to tolerate the progressive pain during an attempted continuous cervical traction for closed reduction.

This case study is provided to highlight the challenges involved in managing an atlanto-axial joint dislocation with locked lateral mass associated odontoid fracture in the absence of neurological disability. The authors present an open reduction with leverage technique for treating atlanto-axial joint dislocation with locked lateral mass. Radiographs at the one-year follow-up revealed that the cervical spine was in correct alignment and had recovered. It is extremely unusual to have an atlanto-axial joint dislocation with locked lateral mass and odontoid process fracture without neurological deficit.

Conclusion

Based on a review of recent publications, traumatic lateral atlantoaxial dislocation combined with locked atlas lateral mass and type IIB odontoid fracture is rarely seen. It is also a very unstable injury. Our proposed leverage technique used in combination with a modified Harms-Goel technique is an effective alternative treatment which surgeons can use in the management of this difficult type of injury.

Declarations

Consent

Written informed consent of the patient was obtained.

Institutional ethics approval

This study has been waived ethical approved for this clinical case study by the ethical committees in accordance with the declaration of Helsinki.

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Author contribution

All writers contributed to the idea for this paper, according to the authors, who affirm their work. The final paper draft was examined and approved by all authors.

Declaration of Competing Interest

All authors declare no conflict of interest.

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