Journal of Clinical and Medical Images

Case Report

ISSN: 2640-9615 | Volume 6

Traumatic Dislocation and Retro-Displacement of C1 Over C2

Asaadi N, Seddighi AS, Seddighi A* and Ghadirian M

Department of Neurosurgery, Functional Neurosurgery Research Center, Shohada Tajrish Comprehensive Neurosurgical Center of Excellencel, Iran

***Corresponding author:**

Afsoun Seddighi,
Department of Neurosurgery, Functional Neurosurgery Research Center, Shohada Tajrish Comprehensive Neurosurgical Center of Excellence, Iran, E-Mail: afsounseddighi@gmail.com

Received: 25 Apr 2022
Accepted: 09 May 2022
Published: 14 May 2022
J Short Name: JCMI

Citation:

Seddighi A, Traumatic Dislocation and Retro-Displacement of C1 Over C2. J Clin Med Img. 2022; V6(8): 1-6

Keywords:

Atlas; Axis; Traumatic; Dislocation

1. Abstract

1.1. Background: Remarkably there is a unique joint in the cervical spine within the C1-C2 level which is considerably responsible for neck rotation somewhat greater than 50 %. What impresses us about joints is that they have been designated ergonomically which allows maximum motion without getting dislocated. It mainly provides six degrees of freedom, the maximum being axial rotation as if nature's engineering has been filling us with wonder by that [1]. As a result of instability, excessive motion, and spinal cord compression, dislocation may occur at the atlantoaxial joint.

Generally, fracture of the odontoid process, laceration in the transverse ligaments or a congenital anomaly can contribute in posterior atlantoaxial dislocation. Merely high-velocity trauma can cause such a severe and uncommon injury [2]. In fact, confrontation of posterior dislocation without any associated fracture of odontoid is extremely rare and so far to the best of our knowledge, only in a few cases reported specifically in this case we're facing a combination state of posterior atlantoaxial joint dislocation and whirling of the anterior arch of C1 behind the C2 which is extremely uncommon.

And despite Anteriority in the vast majority of traumatic C1-C2 dislocations, we bring forward an irregular case of a traumatic posterior atlantoaxial joint dislocation without related any fractures of C1-C2 or any rupture in transverse ligaments of this region that is veritably strange and infrequent. That was treated by an appropriate approach.

2. Case Presentation

A 55-year-old man was referred to our unit following an overturned car accident with quadriparesis (weakness in all 4 limbs) and no loss of consciousness.

On examinations, the patient was alert and oriented to time and space, and responsive to commands. He developed an onset of tetraparesis with no sensory level. Moreover, vital signs were stable.

Examination of force discrimination in limbs was performed and results were reported on bilateral upper extremity: proximal 2/5 and distal 0/5 and on bilateral lower extremity: proximal 3/5 and distal 2/5. The rest of the neurological exams were strictly normal and no signs of myelopathy or radiculopathy were found. The patient have also no signs of generalized laxity in ligaments. X-rays and Computed Tomography (CT) slices of the cervical spine demonstrated a posterior dislocation of the atlantoaxial joints with an anterior arch fracture of C1and no evidence of fracture associated with odontoid (Figure 1 to 4).

Figure 1: CT of the cervical spine (a) Sagittal plane showing posterior dislocation of C1 with respect to C2, (b) Coronal plane of spine displaying anterior displacement of C2 and the dens is located anterolateral to the anterior arch of C1 together with facet joint dislocation of C1-C2 (c) 3D reconstruction of the cervical spine showing C1-C2 dislocation (preoperatively)

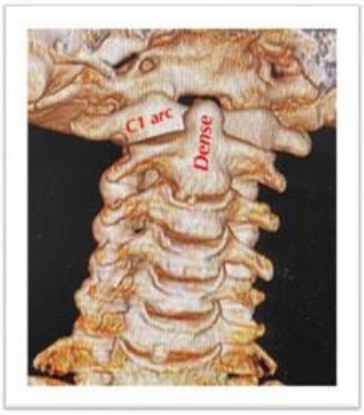

Figure 2: C1-2 joints of the patient with atlantoaxial dislocation using 3D reconstructed CT as seen from the anterior view. In this frontal view gained by 3D Scanner, the long and prominent process of the second cervical vertebrae named dense and arch fracture of C1 created by the dislocation of C1 back the C2 have been demonstrated.

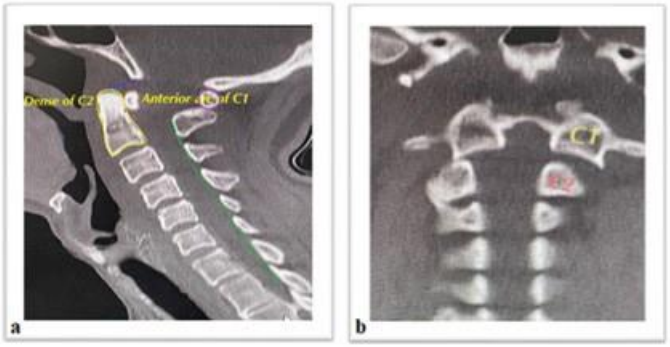

Figure 3: Atlantoaxial dislocations in a 55-year-old man after an overturned car accident. a) Midline sagittal reformatted CT image in comparison with a normal cervical spine in relation to the occiput displays the unusual position of basion and dens relative to each other and consequently an abnormal basion-dens interval(blue line), And also due to extraordinary position of C1 tubercle in back of the dens of C2 representing an atlantoaxial dislocation between the posterior surface of C1 tubercle (the anterior arch of the atlas (C1)) and the anterior surface of the dens of C2 in the median (Lateral view), The green dashed line represents an imaginary line connecting the spinolaminar white lines (the junction between the lamina and the spinous process) and shows that the body of C1 (purple circle is drawn around it) is displaced posteriorly relative to the cervical spine. In this case, there is no measurable atlantodental interval (ADI) between the posterior aspect of the anterior atlas ring and the anterior aspect of the odontoid process an unconventional dislocation has occurred. b) CT image which demonstrates unusual dislocation of C1 back the C2 in Coronal view.

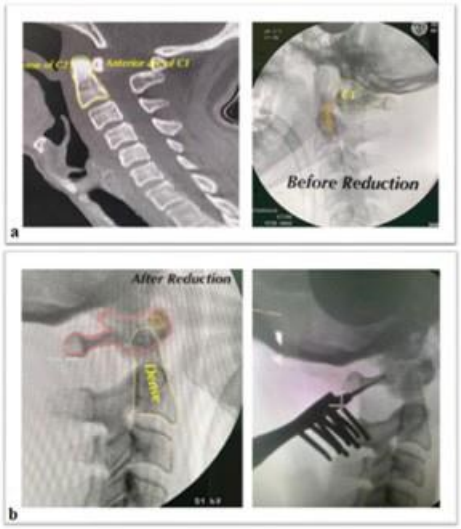

Figure 4: Mid-sagittal CT slices of the cervical spine. a) Pre-reduction and b) Post-reduction

3. Treatment

Under General Anesthesia (GA), the patient was placed in the supine position and under C-arm fluoroscopy guidance and neuromonitoring, manipulation was performed with a Mayfield clamp by the head traction in the caudal-cranial direction and simultaneously a slight flexion for dislocation reduction which was approved by C-arm imaging monitoring. In order to achieve a satisfactory closed manual reduction of the atlantoaxial subluxation, external maneuvers were diligently applied (Figure 5).

Traction technique involves three stages of initial distraction, realignment, and release phases to reposition the joint that during these stages, first by applying slight flexion, C1 ring kept opposed to posterior odontoid until slipping back the C1 over the odontoid, then preventing excessive flexion during distraction by changing the former position. At last, switching to an extension posture and slowly releasing traction over several hours with gradual weight reduction. The attempt of closed reduction failed. We had to proceed for open reduction with posterior stabilization and fusion (Figure 6).

Figure 5: External maneuvers under fluoroscopy

Figure 6: Intraoperative fluoroscopic images before and after reduction. a) Intraoperative closed reduction under image intensifier. b,c) Intraoperative image intensifier images of posterolateral pedicle screw fixation

4. Operative Procedure

The patient was then placed in a prone position and an incision was made in the midline. First, by deepening in line with the skin incision by incising the fascia and nuchal ligament in the midline of the neck, cutting down onto the large spinous process of C2, thus C2 was exposed, then this fascial incision was extended distally onto the spinous process of C3 and then proximally onto the tubercle of C1 and lead to C1 arch was exposed. The transpositioned third segment of the vertebral artery (VA V3 segment) at the upper edge of the C2 lamina was isolated from the surrounding tissue and was protected with surgicel and cotton Then dissection was continued from over the posterior arch of C1 and the ganglion of the C2 nerve was recognized and detached from the C1 Lateral mass by a dissector. Lateral and medial confine of C1 lateral mass was distinguished, then by using Micro drill and Burr-2 drill, the location of the entry point was determined. And under guide on the CARM, the trajectory screw was adjusted and following the tapping, the polyaxial screw 28 x 3.5 was improvised in the C1 lateral mass.

In the following, the lateral range of the C2 pedicle was specified by a dissector, and at a distance of 3-4 mm of the lateral pedicle, the entry point was determined by using a Burr-2 drill. And the C2 pedicle screw 28 x 3.5 was installed with an angle of about 40 degrees medial and 30 degrees cephale. Ultimately, two rods were fixed and the bone graft was placed in the posterolateral range, and the wound was closed after drain implantation. The day after surgery, the patient's muscle force still remained unchanged.

5. Discussion

In a comprehensive review of the English literature in this regard approximately was not found any similar case. In such cases, we have often faced the C1-C2 dislocation of odontoid deformities associated with a fracture so there are some reports of mainly horizontal fractures of the anterior arch thought to occur secondary to hyperextension injuries with subsequent avulsion of the anterior tubercle of the atlas [1-6] Or at least these C1-C2 subluxations were created through transverse ligament lacerations. Anterior instability by dislocation typically ruptures the transverse ligament and increases the Atlantadental interval (ADI) [7-10] and notwithstanding osseous and ligamentous structures are the main contributing factors in clinical stability of the atlantoaxial joints, however, in this special case, there was no evidence of any fracture of the odontoid process and no ligamentous injury or rupture (i.e. transverse, alar, and/or capsular ligaments). [11] Also naturally Atlantoaxial dislocation is so that C1slides over C2 and the orientation of joints decides the direction and rate of slip of C1 over C2 but now particularly in this case slippage of C2 against C1 is prominent, C1 whirled behind the C2 and this exceedingly differentiate it from other cases [12-14].

The vast majority of rotatory dislocations or displacements can be managed with non-operative treatment by observation or traction. Nevertheless, it was a posterior dislocation firstly managed by closed reduction, then Intraoperative traction and placement and screw fixation with a posterior fusion of C1-C2. Therefore, this present scientific literature nominates closed reduction followed by surgical joint fixation and fusion in the level of C1–C2 as a notable treatment.

To our theoretical and practical understanding, conservatively managing a posterior C1-C2 dislocation with an anterior arch of C1 without any fracture has not yet been published. It is also important to remind that there may be significant variation in the severity of the hyperextension mechanism so that the mechanism of posterior atlantoaxial dislocation can be different insofar as it mostly leads to a high-grade hyperextension mechanism [15].

The treatment method is chosen based on the duration of symptoms and clinical presentation (Warner, 2015) and due to neuro deficits in this case, notwithstanding a variety of techniques for arthrodesis, one method by a considerable amount utilizes is C1 lateral mass and C2 pars/pedicle screws. (Hedequist, Spine 2008) The use of the pedicle and pars of C2 as a part of the complex upper cervical spine has allowed spine surgeons to use these structures for fixation of the anterior and posterior segments of the C2 vertebra (Figure 7), as in cases of Hangman's fractures [18].

The upper cervical spine is certainly distinct from instability through having atlantoaxial joints. The Atlas (C1), the first cervi-

cal vertebra which supports the skull, is only a ring of bone made up of two lateral masses joined at the front and back by the anterior arch and the posterior arch that surrounds the spinal cord, which is posterior to the dens. Anterior and posterior atlantoaxial ligaments and the transverse ligament of the atlas are highly significant in the integrity of a complete joint system that is formed by these elements [16]. Unlike in the lower cervical spine, there are facets in level C1-C2 that are oriented in the axial plane and have no bony structure between them prohibiting dislocation. Then this joint exclusively depends on the integrity of the transverse ligament to inhibit anterior dislocation of C1 and the odontoid process contiguous with the anterior arch of the atlas to prevent posterior dislocation [17]. Treatment by C1-C2 posterior fixation is a repetitious technique in the majority of C1-C2 dislocations but it must be considered that overdistraction is assessed as an important pitfall of closed reduction methods [19].

We vividly emphasize that in this case, the authors make the decision based on the injury mechanism analysis and due to anteriority of most dislocations which are responsible for dangerous instability related to a traumatic rupture of the transverse ligament [17] and the posterior nature of this dislocation, and no ligamentous instability was observable.

Posterior atlantoaxial dislocation without any fracture in odontoid process with an isolated fracture of the anterior arch of C1 indicates a very curious injury that may be created and may be safely managed by closed manual reduction under C-arm guidance and open reduction with posterior stabilization and fusion.

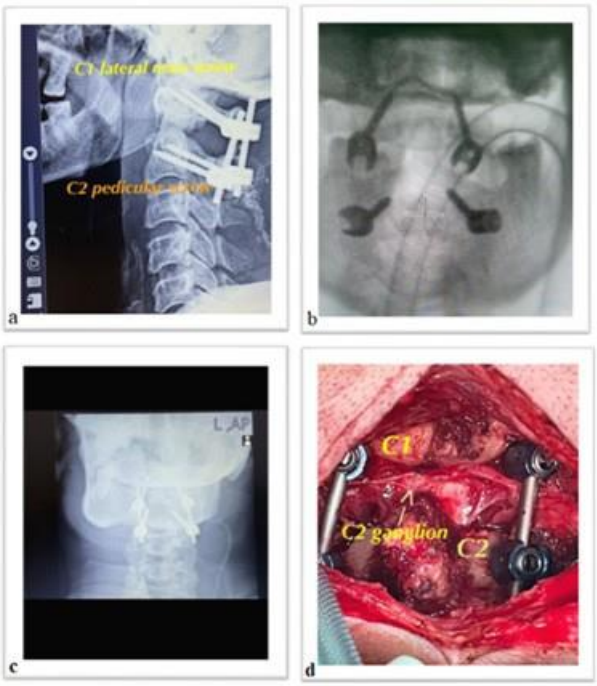

Figure 7: a) C1 lateral mass and C2 pars/pedicle screws in sagittal view b,c) Postoperative radiograph of patient after modified implant demonstrating the satisfactory position of implants d) Realignment using the long rod holder and the loosely fastened rod onto C1-2 screws. The long rod holder acts as lever and caudal force realigns the C1-2 in anteroposterior plane whereas clockwise or anticlockwise force corrects the lateral translation.

6. Conclusion

In order to provide maximum axial rotation without dislocating, Naturally C1-2 joints have been designed ergonomically. Admittedly fusing the C1-2 joints needs a construct that can avoid any translation and rotation in any axis. To put it more accurately excellent stability can be provided by fusing the C1-2 joints close to the articular surfaces. From significant Considerations is that the deformed joints are prone to dislocation. The level of dislocation and the rate of slip is decided by the direction of deformity. Transarticular screws on both sides, anterior or posterior, are a good alternative [20]. Transarticular screws and C1 lateral mass with C2 pedicle screws provide similar stiffness [21]. As a matter of fact, Realigning is possible by deformity correction. Though not the best treatment, C1-2 realignment and arthrodesis may become necessary for stabilizing C1-C2 and preventing it from deterioration or new development of neurologic symptoms, and maybe the best option at the present time is available.

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