Odontoid Type I Fracture (Report of a Case Complicated with Atlantoaxial Dislocation)

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ABSTRACT
Odontoid type I fracture is an avulsion fracture of the odontoid tip resulting from forceful distraction of the alar ligament and has been reported only in a few rare occasions. We have recently encountered an odontoid type I fracture complicated with atlantoaxial dislocation in an 18-year-old male motorcycle rider sustaining neck injury in a crash. An accurate diagnosis was achieved with axial and reconstructed CT images. The patient was managed successfully with combination of transarticular C2-C1 screwing and posterior wiring technique after application of light skull traction. We could not find a similar case with a literature survey.

KEY WORDS: Cervical spine trauma, Classification, C2-C1 Transarticular screwing, Odontoid fractures, Outcome, Upper cervical

INTRODUCTION
Odontoid type I fracture is a rare entity and is mostly known as a very benign fracture responding to external immobilization.(1,10,13,18,22,23,24) However, all such fractures should not be regarded simple and benign, because they might be only a dangerous sign of underlying upper cervical injuries.(7,20) Through careful review of the literature, we could find only a few cases complicated with atlanto-occipital dislocation while not a single case of atlantoaxial dislocation could be encountered. We therefore found this case worthy of presentation.

CASE REPORT
An 18-year-old man riding a motorcycle ignored a car parked in the street, collided with the right rear side of the car and fell to the ground. Wearing a helmet, he was unconscious for only a few minutes. He noticed paralysis of his left upper extremity with some degree of neck pain as soon he became fully oriented. He was transferred to a local hospital. Brachial plexus injury of the left side was diagnosed. Plain radiographs taken at the nearest hospital showed suspected atlantoaxial subluxation (Figure 1). He was therefore transferred to a trauma center of the same city and was later referred to us for further investigation and possible surgical intervention.

Cervical spine X-Rays were reviewed and showed increased distance of spinal processes of C1 and C2 and ADI in lateral images suggestive of atlantoaxial subluxation, although the AD interval was hazy. An increased prevertebral shadow was also noticed.

Axial CT and 2D reconstruction CT scan revealed avulsion fracture of the tip of odontoid with engagement of the avulsed segment anterior to the odontoid peg and posterior to the arch of atlas with marked atlantoaxial dislocation. (Figure 2A,B). 3D CT images clearly showed atlantoaxial subluxation (Figure 2C)

MRI taken later showed the atlantoaxial subluxation but did not add more information, except for root avulsion at the level of C5

Applying 10 pounds weight head traction resulted in good alignment with reinstallation of the odontoid
peg through disengagement and approximation of the fractured fragment to dense. A day later, stabilization was achieved through transarticular C2-C1 screw purchase supplemented with posterior interspinous wiring adding an autogenous iliac graft (Figure 3A,B). Postoperative CT images confirmed approximation of the fractured segment to the peg as well as the accuracy of transarticular screw position (Figure 4A-C).

The postoperative course was uneventful and he was discharged within 5 days afterwards.

**DISCUSSION**

Type I odontoid fracture, known as avulsion fracture of the cephalad portion of odontoid, is described as an oblique fracture that appears to result from distraction on the occipital portion of alar ligaments. This type has been the least common variety of odontoid fractures in the literature (1,8,13,18,19,22,25).

The incidence of Type I is conflicting. Surveying most of the large series of odontoid fractures in the literature,
we failed to find a single case of type I (2,3,6,12,14,15,16,17,21) while on the other hand it was found to be from 1% in Green and up to 4.1% in the Anderson & D’Alonzo series.(1,8,13,18,19,22,25)

However, with careful survey of several large series of odontoid fracture in the literature, we found the incidence to be about 0.8%.(1,2,3,6,8,13,14,15,16,17,18,19,21,22,23,25)

Reviewing the reported cases, We conclude that it is productive to classify this type of odontoid fracture into two separate entities, isolated or Type I a and complicated or type I b. Isolated cases are those which are confined to the dense and are considered stable injuries.(8,10,18,19,22,23,24) The complicated type is associated with potentially more worrisome and ominous occult upper cervical dislocations, mostly atlanto-occipital dislocations (7,20). However, after surveying all the pertinent literature, not a single case associated with atlantoaxial dislocation could be found.
Isolated cases of type I odontoid fractures should be regarded stable unless other serious ligamentous injury occur concurrently. Therefore, they have a benign course and have almost always responded to conservative measures in all reported cases, especially a halo vest or Minerva immobilization. All patients with this subtype therefore survive and return to previous activities within 8 to 12 weeks.

The clinical picture and course of the patients with complicated subtype Ib is influenced by associated severe ligamentous affection and are usually fatal. In this subtype, the presence of odontoid type I fracture is only a good radiological marker for the severe underlying upper cervical dislocations.

Atlanto-occipital dislocation has mostly been reported with the occurrence of such a severe upper cervical Ligamentous injury as was shown by Eismont and later by Scott, while the atlantoaxial dislocation which was seen in our case should be the first reported one in the literature associated with type I odontoid fracture.

Type I avulsion fractures were shown to most likely result from the head in rotation and flexion causing maximal traction on alar ligaments in a series of cadaver studies.

In our case, the head struck the left rear side of the car on the right side of the head with the head rotated the left; subsequent flexion of the head resulted in avulsion fracture of the odontoid. With probable continuation of the flexion the transverse ligament was torn and the avulsed part was impacted between the arch of atlas and odontoid peg. The left hand holding the motor handle was stretched and resulted in brachial plexus avulsion on the same side.

From clinical point of view, atlantoaxial subluxation with intact odontoid process is potentially associated with more serious neurological injury. This is in contrast to the subluxation seen with a fractured and displaced dense, in which neural impairment is seen at a lesser degree and in a small number of the subjects. In such circumstances, although up to 25% of the causalities can be affected neurologically, the degree of neural impairment is minor in majority. In our case, the main portion of the odontoid was intact resembling sound dense, with diminished space available for the cord but luckily neurological deficit or myelopathy was absent.

Pain and stiff neck are the cardinal picture in majority of odontoid fractures, as in our case. Brachial plexus avulsion was seen in two occasions of type I including our case.

A good plain X-Ray including an open mouth view can show avulsion fracture of odontoid in this type of fractures. In our case the anteriorly displaced atlas arch, indicative of atlantoaxial dislocation, was clearly seen. However, the AD interval was surprisingly obscured, and later noticed to be packed by the avulsed bone fragment. The prevertebral soft tissue shadow was also increased, indicating upper cervical injury.

CT and CT reconstruction images seem to be the diagnostic tools of choice in both subtypes of odontoid type I fractures.

In our case, we could clearly understand the events through CT and CT formatted images, in which the oblique avulsion of a fragment from the dense and its impaction in AD Interspace as well as the atlantoaxial subluxation could be seen clearly. Moreover, the usefulness of CT images in postsurgical evaluation should be emphasized.

MRI is also of great value specially in complicated cases, and posterior ligamentous complex and transverse ligament disruption can be detected in such instances. Further, the position of odontoid peg in relation to the neighboring bony structures can be assessed by which atlantoaxial or atlanto-occipital dislocation can be easily diagnosed. Increased prevertebral shadow is also a good indicator of upper cervical spine injury. In our case anterior subluxation of the atlas without cord compression was demonstrated as well as increased prevertebral soft tissue shadow.

An isolated or subtype Ia is stable and conservative management with rigid plastic collar for at least 8 to 12 weeks should be appropriate therapy. But in Subtype Ib all measure should be used to confirm associated dislocations and its surgical treatment.

Traction is not recommended in isolated type Ia cases and it might have counterproductive effect, while in Subtype Ib because of associated dislocation, it is fully supported as it was clearly seen in Eismont and present case.

Our case is unique because it was associated with marked atlantoaxial dislocation and survival. Atlanto-occipital
dislocation should be managed with cranio cervical instrumentation (7,20) while cases such as our unique case with atlantoaxial dislocation are best treated with transarticular C2 C1 instrumentation supplemented with posterior wiring and autogenous bone graft, as we did. (11). Posterior wiring techniques alone are associated with a high rate of failure in atlantoaxial subluxation (9). However, transarticular screws traverse two vertebrae and make a potent internal fixator resistant to translation and rotation and resistance against extension can be achieved with conjunction of autogenous bone and interspinous wiring, providing optimal milieu for stabilization and fusion (11). 

In our case luckily with gentle traction, the avulsed fragment of odontoid was disengaged and approximated to the peg and with subsequent extension of the head, C1- C2 alignment was achieved making it feasible for transarticular screw fixation. 

The outcome of Type I odontoid fracture depends on its subtype. Type Ia cases are almost always associated with excellent results (10,13,18,19,24), while the associated head injury and failure to diagnose the concurrence of upper cervical injuries have a negative impact on the outcome and even death might ensue in Subtype Ib (20). Early and accurate diagnosis of associated dislocations can avert such untoward complications with resultant survival and good outcome as was seen in the third case of Eismont and our case (7). 

The review of our case ultimately emphasizes thorough evaluation of type I odontoid fractures in order to rule out the possibility of a life-threatening associated upper cervical dislocation.

REFERENCES
6. Dunn ME, Seljeskog EL. Experience in management of odontoid process injuries (an analysis of 128 cases) 18: 306-310,1986

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