Anterior Screw Fixation for Odontoid Fracture: A Report of Three Cases

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Anterior screw fixation of Type II odontoid fracture provides immediate stabilization of the cervical spine while preserving C1–C2 movements. This technique has a high fusion rate despite its technical difficulty. C2 odontoid process fracture accounts for 10- 20 % of all cervical spine injuries, most frequently occurring at the junction between odontoid process and the body (type II), which causes atlantoaxial instability. This compromises the cervical spinal cord functions due to compression and thus surgical correction is imperative.

We present 3 cases of anterior lag screw fixation for odontoid fixation and stabilization. Two of them had type two odontoid fracture due to motor vehicle accident and one had idiopathic increased cranio-cervical distance. Preoperatively there was no neurological deficit in any of cases, operation was planned based on radiological findings. MRI of cervical spine was done in all cases to rule out any spinal cord injury. Post operatively all three cases were neurologically intact and all of them were discharged within 1 week of surgery and were kept in regular follow- up.

Keywords: anterior screw fixation, atlanto-axial stabilization, complications, odontoid fracture.

Odontoid process fracture accounts for 10- 20 % of all cervical spine injuries, most frequently occurring at the junction between odontoid process and the body (type II), which causes atlantoaxial instability. They are potentially serious due to the life-threatening neurologic risk entailed by the proximity of the medulla oblongata and the great mobility of the cranio-cervical

junction (C1-C2 axial rotation), exposing it to a higher risk of instability. They are thus associated with elevated morbidity and mortality.[1]

Types of Odontoid fracture has been shown in **Figure 1**. Here we present 3 cases of post traumatic odontoid fracture who came to emergency in our hospital. We have tried to show, in this report, how odontoid fracture should be managed and we have also reviewed the literature.

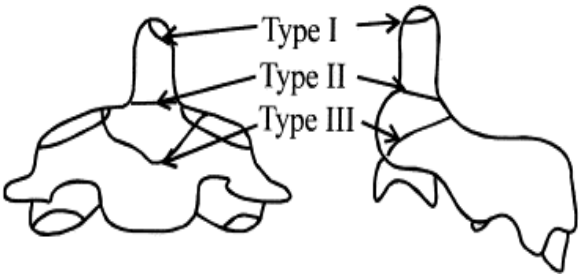

Figure 1: Anderson and D'Alonzo's classification of odontoid fractures. Note that Type I injuries are at the tip of the odontoid. Type II injuries are at the base of the odontoid. And, Type III injuries extend into the cancellous C2 body

Case Reports

The results of anterior fixation of odontoid is demonstrated by prospective case series of 3 patient received from 2017 and 2018. Preoperatively, there was no neurological deficit in any of cases, surgical management was planned based on radiological findings. MRI of cervical spine was done in all the cases to rule out any spinal cord injury. Post operatively all three cases were neurologically intact, except first patient developed persistent bradycardia for first few days and first two patients had dysphasia in initial days which became better within few days after surgery. All of them were discharged within 1 week of surgery and were kept in regular follow- up.

Brief description of cases has been shown in **Table 1**.

Case 1

A 33-year-old male patient presented to our Emergency Department with history of motor bike accident sustaining injury over neck region, complaining severe neck pain. He had reduced cervical range of movements with local tenderness. His upper limb examinations revealed no

SN	Age/Sex	Symptoms	Pathology	Outcome
1.	33y, M	Severe cervical tenderness with no neurological deficit	Road traffic accident	Improved
2.	21y, M	Severe cervical tenderness with no neurological deficit	Road traffic accident	Improved
3.	27y, M	Severe cervical tenderness with no neurological deficit	Road traffic accident	improved

Table 1: Table showing brief descriptions of three cases

Figure 2: A) X-ray plain cervical spine, B) CT scan of cervical spine showing type II Odontoid fracture of case no. 1

neurological deficit. His cervical X-ray revealed doubtful odontoid fracture. CT scan of cervical spine confirmed type II fracture odontoid **(Figure 2)**.

Case 2

A 21-year-old male patient presented to neuro OPD with complains of severe neck pain following road traffic accident 2 days back. He had severe cervical tenderness with restricted movements of cervical spine. His neurological examination shows no neurological deficit except marked local tenderness in the neck. His radiological investigation revealed type II odontoid fracture **(Figure 3)**.

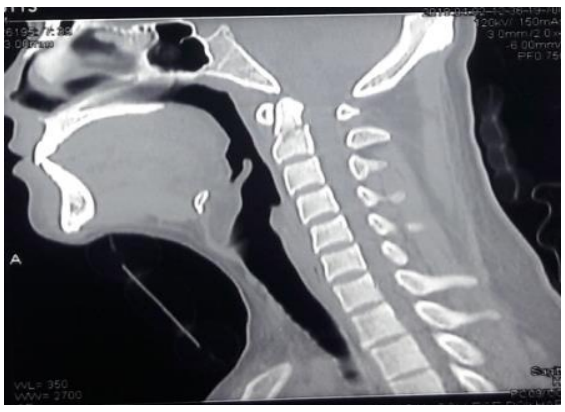

Figure 3: CT scan of cervical spine showing odontoid fracture of case no. 2

Case 3

A 27-year-old male patient came to our Emergency Department with gross scalp injury following road traffic accident. His screening cervical X-ray and CT scan showed odontoid fracture and increased cranio-cervical distance. He has no neurological deficit except mild to moderate local pain.

Surgical Procedure

The patient is placed supine and positioned in such a manner that the odontoid fracture is best oriented so as to achieve optimum reduction. The patient's mouth is kept open with jaw distractor. Initial fluoroscopic images are obtained in the AP and lateral planes. A horizontal incision is made at approximately the level C5. The platysma is then elevated and divided, and the fascia

of the sternocleidomastoid is sharply incised along its medial border. Blunt dissection is used to expose natural planes medial to the carotid artery sheath and lateral to the trachea and esophagus. The fascia of the musculus longus colli is

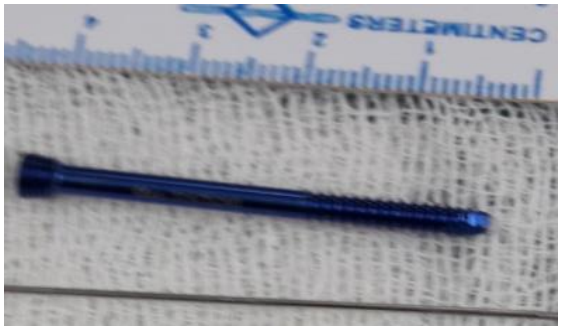

Figure 4: Cannulated Lag screw

incised in the midline, and the muscle is elevated from the vertebral bodies at the C4-5 level.

Blunt dissection in the retropharyngeal pre-vertebral space was done to open a tunnel in front of the vertebral bodies to the C-2 level. A midline entry site was chosen for a single lag screw. A shallow groove was made in the anterior surface of C-3. A K wire was fitted in the drill guide system and K wire was inserted into the odeontoid process under C-arm guidance targeting tip of the odontoid process. Once the K wire was properly inserted into the odontoid process cannulated lag screw **(Figure 4)** was placed over the K wire and the screw inserted upto the tip of the K wire. X-ray AP and Lat view were taken to confirm the appropriate placement of lag screw.

The head of the screw was recessed into the shallow groove made on the body of C3 and the screw tip was fully engaged into the apical cortex of the odontoid. The angle of screw placement was such that the spinal cord was not injured. The wound is checked for hemostasis, and closure is completed in layers. We use interrupted absorbable sutures in the sternocleidomastoid muscle fascia, platysma muscles, and subcutaneous tissues, and we use prolene sub cuticular

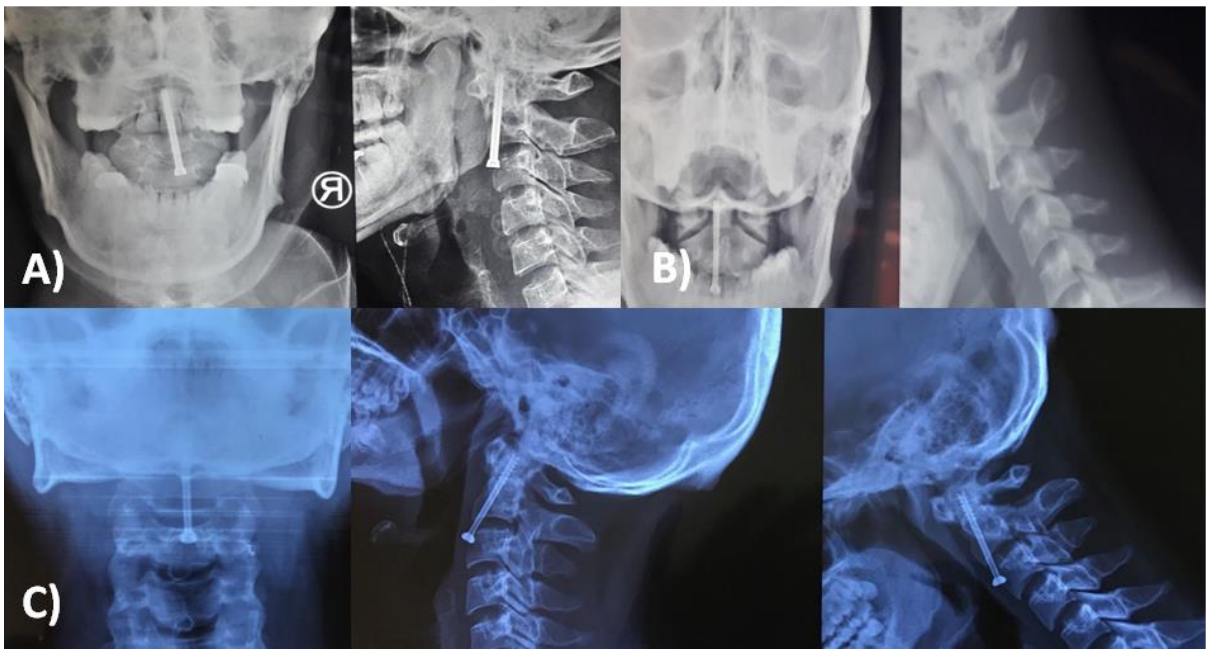

Figure 5: post operative images, A) Post-op X-ray of first patient, B) Post-op X-ray of second patient, C) Post-op CT scan of third patient

suture for skin closure. [2]

We followed same procedure in all our cases.

Discussion

Odontoid fracture accounts for 10-20 % of cervical spinal injuries.[1] These injuries usually result from falls in the elderly people or high-velocity accidents in the young and middle-aged ones. The fracture mechanism is generally hyperextension or hyperflexion of the cervical spine.

Fractures of the odontoid process were classified into three types based on anatomical location according to the scheme of Anderson and D'Alonzo.[2] Jonathan et all divided type II odontoid fracture into 3 subtypes viz. subgroup A non-displaced, subgroup B Anterior superior to posterior inferior and displaced transverse fractures, subgroup C Anterior inferior to posterior superior or comminuted fractures. These fractures most often occur at the junction of the odontoid process and the body of C-2 (Type II) or in the body of C2 (Type III) and result in atlantoaxial instability. Because of the instability associated with these lesions, patients are at significant risk for immediate or delayed catastrophic spinal cord compromise and achieving spinal stabilization is imperative.[3] Current methods for stabilization of odontoid fractures require rigid external immobilization or surgical fixation. External immobilization with a rigid orthosis can allow the fracture to fuse without the need for surgical intervention, but it is limited because of higher nonunion rates and prolonged limitation of the patient's function. In surgical stabilization procedures surgeons have relied primarily on posterior atlantoaxial fusion in which they use a variety of bone and wire constructs. Even though posterior fusion is associated with lower rates of nonunion, it eliminates normal C1–2 rotatory motion, which accounts for more than 50% of all cervical spine rotatory motion, and reduces cervical spine flexion–extension by 10%.[4]

We followed anterior retro pharyngeal approach for anterior screw fixation. This technique has been previously described in detail by Apfelbaum et al.[5]

Practically it was not easy to screw the fractured segments of odontoid process, in our cases, during surgery due to lack of biplane C-arm. With the help of simple C-arm it was very difficult to take AP and Lat view X-rays after each step of screw insertion. It was quite time consuming and tiring. As a result, achieving exact anatomical alignment of screw was very difficult. Despite all the difficulties we could achieve relatively good alignment and fixation of odontoid process as can be seen in post-op X-rays **(Figure 5)**. With experience screw insertion became easier and faster in our cases. All the cases had good fusion of odontoid fractured segments and all of them became stable in subsequent follow up.

Careful selection of patient considering anatomy and morphology of fracture ensures better outcome, providing much higher rate of fusion (82%) with anterior approach than non-operative management

with a rigid cervical collar (51%) or halo vest (65%).[6] The degree of dens dislocation (4-6mm)[7-8] increasing age (40-65 years)[9,10] posterior odontoid subluxation[10] and comminution of base of dens[11] would predict lower rates of fracture union.

Conclusion

Anterior screw fixation of dens is the standard technique of management in case of odontoid fracture. This technique is simple and effective. It confers immediate stability of the spine and provides an optimum anatomical environment for bone healing. Though it may become difficult technically in the absence of good quality C-arm or fluoroscopy, it can be easily learnt if done regularly. In addition, it is cost effective and relatively straightforward technique without much intra-operative complications if done carefully. There is no need to stay in ICU after surgery and patient can be discharged within few days.

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