

Anterior transarticular screw fixation as a conventional operation for rigid stabilization

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Abstract

Background: Anterior transarticular screw (ATS) fixation is a useful surgical option for atlantoaxial (AA) stabilization. This report presents a revised ATS method for AA fusion.

Methods: A 79-year-old male presented with AA instability attributed both to an old odontoid fracture and severe degeneration of the lateral atlantoaxial joints (LAAJs). ATS fixation was performed through the conventional anterior cervical approach. The longest screw trajectories were planned preoperatively using multiplanar reconstruction computed tomography (CT) scans, with entry points of the screws situated at the midpoint on the inferior border of the axial body. The surgical exposure was limited to opening at the entry points alone. Our retractor of choice was the Cusco speculum; it sufficiently secured space for utilizing the required instruments for screw placement while offering sufficient protection of soft tissues. Cannulated full-threaded bicortical screws stabilized the LAAJs. Screw insertion required a significant amount of coronal angulation up to the superior articular process of the atlas under open-mouth and lateral fluoroscopy image guidance. After ATS fixation, bone grafting was performed between the posterior laminae of the axis and the atlas through a conventional posterior approach.

Results: Bony fusion between the atlas and the axis was confirmed radiographically. Arthrodesis of the LAAJs occurred despite no bone grafting.

Conclusions: Rigid fixation of the LAAJs was obtained by our ATS technique, indicating that it is an alternative method for AA fixation when posterior rigid internal fixation is not applicable.

Key Words: Anterior transarticular screw fixation, atlantoaxial instability, facet degeneration, odontoid fracture

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INTRODUCTION

Anterior transarticular screw (ATS) fixation is a useful surgical option for atlantoaxial (AA) stabilization. Here, we report a patient with an old odontoid fracture and severe degenerative changes of the lateral atlantoaxial joints (LAAJs) who was treated successfully with ATS fixation. Our method included the utilization of conventional surgical techniques plus rigid stabilization to attain solid fusion between the atlas and the axis.

METHODS

Present history

A 79-year-old male presented with progressive severe myelopathy. On admission, his Japanese Orthopedic Association (JOA) score was 6/17. X-ray studies confirmed severe AA instability, while the computed tomography (CT) showed marked cord compression and AA subluxation secondary to an old odontoid fracture, lateral dislocation of the axis, and severe degeneration of both LAAJs [Figure 1a]. The Myelo-CT study further confirmed relief of compression in extension [Figure 1b-e]. Of note, three-dimensional CT angiography showed a high-riding vertebral artery (VA) that narrowed the right pedicle of the axis.

Surgical planning

Following these examinations, the patient's neck was fixed in extension utilizing a halo vest; this corrected the AA alignment. ATS fixation was chosen due to the

high-riding VA and because the AA subluxation was corrected in extension.

Screw trajectories

Screw trajectories were planned preoperatively using multiplanar reconstruction CT scans [Figure 2]. Serial symmetrical coronal sections were created from the entry points of the screws, which were positioned at the midpoint on the inferior border of the axial body. We chose a section that enabled us to create the longest screw pathways possible from the entry point through the axis and atlas. We checked the direction of the pathways in the coronal plane [Figure 2a, black arrows] and the sagittal plane [Figure 2b, white line].

Anterior surgery

Using a standard anterior cervical approach, the vertebral bodies of the middle cervical spine were exposed. Blunt dissection then proceeded cranially along the anterior surface up to the C2-3 intervertebral disc. A Cusco speculum was placed to secure the operative field. Under biplanar fluoroscopy image guidance, a Kirschner-wire was introduced as a guide from the midpoint on the inferior border of the axis to the superior articular process (SAP) of the atlas, following the preoperative planning for the screw trajectories. The depth to the SAP of the atlas was measured, and a cannulated full-threaded screw of the same length was inserted.

Posterior surgery

After the ATS was finished, the patient was turned to the prone position. Through a conventional midline

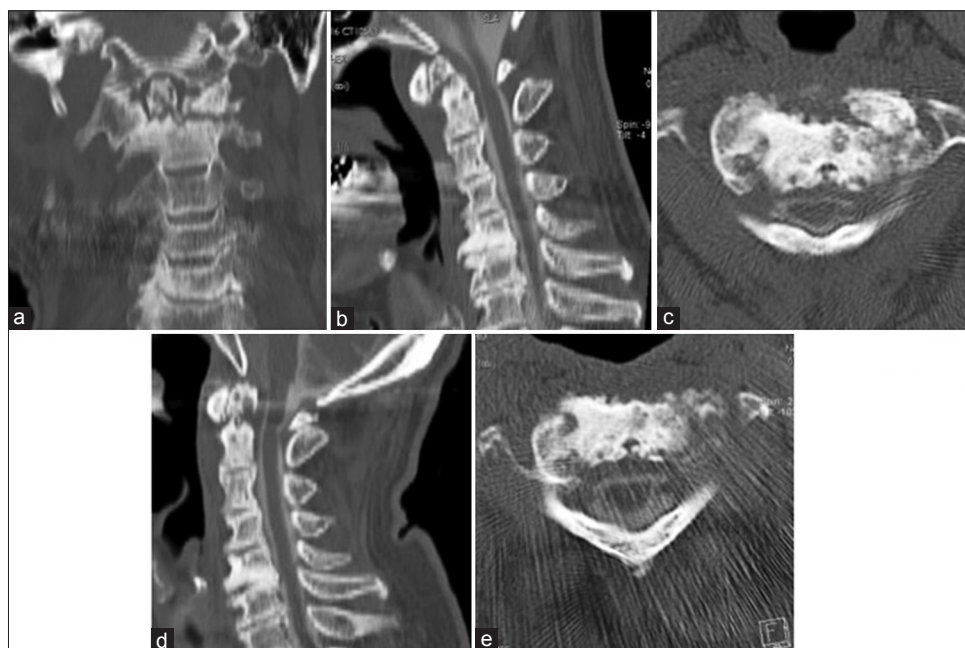


Figure 1: Preoperative computed tomography (CT) scans. a Coronal image shows old odontoid fracture, lateral dislocation of the atlas on the axis, and severe degeneration of the lateral atlantoaxial joints. b-e CT myelograms in a flexion-extension study shows that spinal cord compression was induced by atlantoaxial subluxation (AAS) in neck flexion (b, c) and that the compression was released by correction of the AAS in neck extension (d, e)

posterior approach, iliac bone grafting on the laminae of the atlas and the axis was performed to secure bony fusion. We did not add any other methods to enforce AA stability.

Postoperative course

The patient started rehabilitation the next day wearing a soft neck collar, which was continued for 3 months. His symptoms of cervical myelopathy diminished gradually, and he became ambulatory without support (JOA score of 10/17).

Postoperative CT scans obtained just after the surgery showed that the bilateral screws were placed accurately [Figure 3a]. Although the AA alignment

was corrected [Figure 3b], spaces in both the LAAJs and pseudoarthrosis of the odontoid fracture were seen [Figure 3a, b]. Six months postoperatively, the spaces were filled with bone, and solid fusion was observed [Figure 3d, e]. Bony fusion was also obtained in the posterior elements between the atlas and the axis [Figure 3c, f].

DISCUSSION

Utility of ATS fixation through conventional Anterior Cervical Approach

ATS fixation has been performed through the anterior retropharyngeal approach.^[1,2,3,5] Because wide tissue dissection is unavoidable with this approach, there is latent danger of tissue injury to the throat, trachea, esophagus, pharynx, major vessels, and lower cranial nerves. Advances in posterior instrumentation techniques and the technical difficulty of the anterior retropharyngeal approach have been cited as reasons why ATS fixation is rarely the procedure of choice. Recently, however, there have been a few reports on ATS fixation using minimally invasive techniques, such as microendoscopy and percutaneous screw systems.^[4,6] Although wide tissue dissection is unnecessary for these methods, there seems to be a higher risk of tissue injury during introduction of devices into the unopened operative field. We believe that our method of ATS fixation using conventional anterior cervical approach will be accepted more easily.

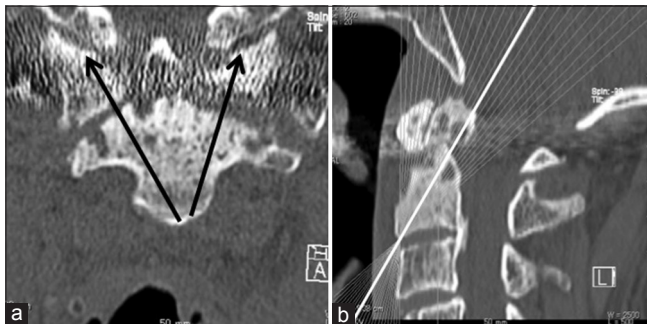


Figure 2: Preoperative planning for screw trajectories using multiplanar reconstruction CT scans. Serial symmetrical coronal sections were created from the midpoint on the inferior border of the axial body. We found a section that enabled the longest screw pathways (black arrows) (a). The sagittal angulation of the section on the scout image (white line) presented a direction of screw insertion in the sagittal plane (b)

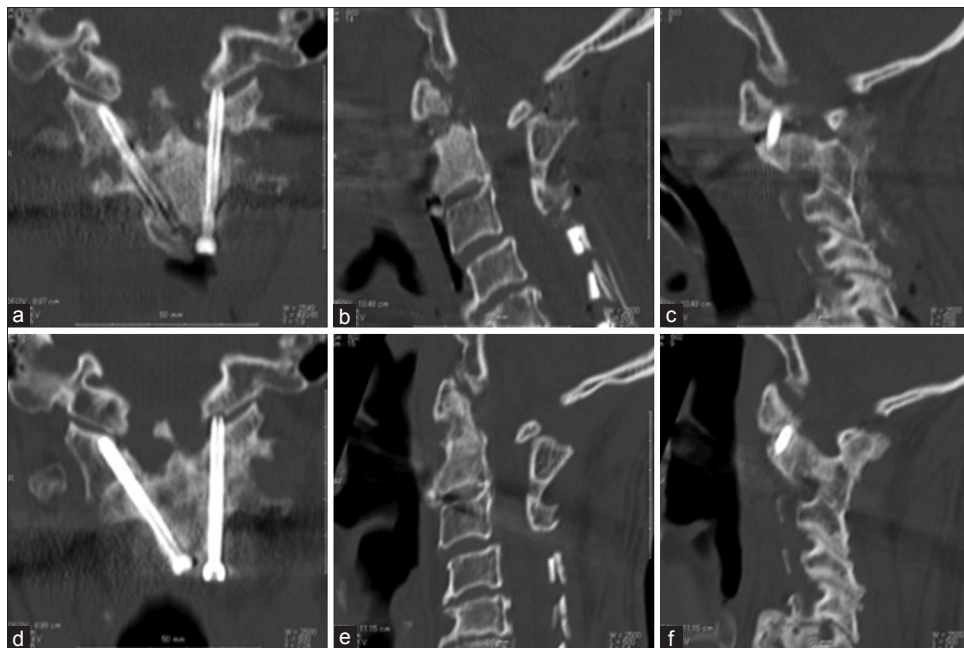


Figure 3: Postoperative CT scans obtained the day of the surgery (a-c) and at 6 months postoperatively (d-f). Gaps seen in both lateral atlantoaxial joints (a) and the odontoid process (b) just after the operation were replaced with generated bone at 6 months postoperatively (d, e). Bony fusion was also obtained on the lateral side between the laminae of the atlas and the axis (f), on which autologous bone graft was transplanted (c)

Attributes of the cusco speculum for ats exposure

We utilized a Cusco speculum as the wound retractor to perform ATS fixation via the conventional anterior cervical approach. Its shape helps open the deep operative field without soft tissue injury. One recent article reported ATS fixation through a conventional anterior cervical approach,^[7] but it failed to discuss the Cusco speculum that facilitate ATS in this method.

Use of full-threaded versus lag screws

We attempted to increase the stability of ATS by modifying the methods for screw fixation, using full-threaded versus lag screws. Full-threaded screws stabilize the axis via the placement of bicortical screws; they therefore provide more rigid/stronger stability. Second, we placed the entry points of the screws at the midpoint on the anterior border of the axis (e.g. versus prior studies using approach 5-10 mm lateral from the midpoint, or at the groove beneath the SAP of the axis^[7]), enabling us to place longer screws through the axis, thereby preventing screws from cutting out and strengthening fixation stability. Additionally, revising the entry points to the midpoint enabled us to insert screws with greater angulation from the sagittal plane, while

lateralization of the screws increase the rigidity of the screw fixation.

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