Management of Traumatic Cervical Spondyloptosis

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Abstract

Traumatic cervical spondyloptosis is a 3-column fracture-dislocation resulting in a highly unstable spine requiring urgent reduction, stabilization, and fixation. Since its occurrence is not that common, there are a lot of controversies concerning its management. A holistic approach has been proposed regarding the management of traumatic cervical spondyloptosis.

Keywords
- ASIA impairment scale
- cervical
- instrumented fusion
- pre-reduction MRI
- spondyloptosis
- traction
- traumatic

Introduction

Traumatic cervical spondyloptosis is a 3-column injury that is highly unstable and requires immediate reduction and stabilization, either open or closed. It was first defined in the literature as a complete intercorporal displacement in the cervical spine.[1] It is a complete segmental disruption leading to devastating consequences. There is no definite consensus when it comes to its management. However, there are several different management options described in the literature ranging from a simple anterior or posterior approach to 540-degree fusions.

Mechanism of Injury

In this kind of injury, the affected vertebral body is completely dislocated either anterior or posterior to the subjacent vertebral body. Most of these injuries are high-impact trauma cases comprising high-speed road traffic accidents, fall from height, or diving accidents.[2] Allen et al proposed a mechanistic classification of cervical spine injuries based on direction of forces acting during trauma.[2] This included six categories: compressive flexion, vertical compression, distractive flexion, compressive extension, distractive extension, and lateral flexion. Each category has various stages graded from least severity to the most.

Based on this classification, spondyloptosis can occur either during stage 4 of distraction flexion (DF4) or stage 5 of compressive extension (CE5). During DF4 injury, the facet joints are completely unhinged/dislocated anteriorly leading to a grossly unstable motion segment causing a "floating vertebra." This also leads to canal compromise and neurological deficits (►**Fig. 1**). During CE5 injury, there is complete disruption of soft tissues anteriorly as well as posteriorly and the compression force vector causes bilateral posterior arch fractures (lamina/pedicle/facets/combined injuries) leading to anterior vertebral body displacement (►**Fig. 2**).

Neurological Deficits

Based on the review of literature, a total of 47 patients with traumatic cervical spondyloptosis have been reported, out of which 9 (19%) patients have had complete cord injury (ASIA A). Neurological status depends on canal compromise. In DF4 injury, the spinal canal gets compromised as the posterior

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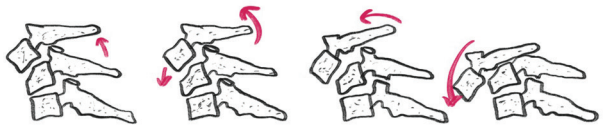

Fig. 1 Flexion-distraction injury showing the various forces acting on the cervical spine with resultant dislocation and jumped facets.

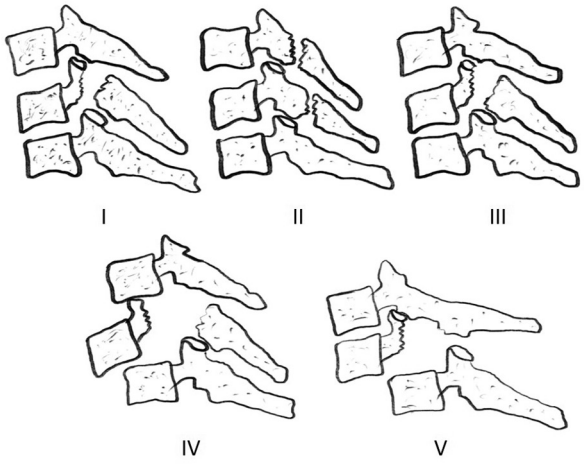

Fig. 2 Compressive extension injury is divided into five stages: Stage **I**: Posterior arch fracture that may be facet, pedicle, or lamina fracture, with or without rotation that can result in mild anterior translation (lateral mass fractures). Stage **II**: Bilateral lamina fractures (single/multiple levels). Stage **III**: Bilateral lamina, facet, pedicle fractures without vertebral body displacement (floating lateral mass fractures). Stage **IV**: As for stage **III**, with partial anterior vertebral body displacement. Stage **V**: As for stage **III**, with 100% anterior vertebral body displacement.

elements dislocate with the vertebral body as a single segment compressing the cord, leading to neurological deficits. Also, the spinal cord gets kinked during flexion injury leading to worsening of deficits. However, in CE5 injury, the spinal cord may get spared due to the fact that the posterior elements get fractured that leads to the natural decompression and widening of spinal canal. Moreover, due to extension in CE5, the spinal canal maintains the normal lordotic alignment with no resultant kink. Such cases with no neurological deficits have been reported by various authors.[3-10]

Investigations

After resuscitation and stabilization of vitals, the patient (hard cervical collar on since the time of injury) is screened with cervical spine X-ray with anteroposterior and lateral views. Noncontrast computed tomography (CT) whole spine is done to look for bony anatomy and fracture-dislocations. Magnetic resonance imaging (MRI) cervical spine is a valuable tool to assess for any anterior cord compression (disc prolapse, hematoma, or fracture fragment). Some authors propose to get MRI done before applying traction as traction can worsen the anterior compression and can result in neurological deterioration.[4,11,12] CT angiography or MR angiography is done to rule out vertebral artery injury. Radiology of a case who sustained cervical spine injury has been shown in ►**Fig. 3.**

Presurgical Management

Presurgical management starts at the scene of accident by immobilizing the patient with a hard cervical collar and shifting the patient via log rolling. On arriving at the hospital, ABCDE are assessed and patient is resuscitated. Cervical immobilization (hard cervical collar) is the norm until cervical spinal injury has been ruled out.

The ultimate goal of any intervention in this scenario is to preserve neurology and prevent further neurologic injury.[10] The best way to achieve it is by applying traction. The traction provides time between injury and surgical stabilization. The traction may restore the anatomic alignment thus converting a grade 5 listhesis to a lower grade or even complete reduction in addition to providing stability. The traction should be applied in a conscious patient who can be assessed clinically.[13]

The traction is applied 2 cm posterior to the interaural line below the equator of the skull to cause a flexion moment that facilitates reduction in facet dislocation. The pins are tightened until spring loaded indicator protrudes 1 mm above surface (this is the equivalent of 139 N [14 kg] of force) (►**Fig. 4**).

The traction is applied with an initial weight of 4 kg that is then gradually increased by 4 kg increments every 20 minutes till complete reduction in dislocation is achieved or the patient shows neurological deterioration (whichever comes earliest). Serial radiographs are done after each weight increment. The maximum weight used is up to 63 kg.[14] ►**Fig. 5** shows post-traction imaging of a partially reduced cervical spondyloptosis.

Management

A pre-reduction MRI is still a controversial thing when it comes to stabilizing the cervical spine. Some authors suggest to get an MRI before applying traction to rule out anterior compression,[11,12] whereas there are others who believe that applying traction does not worsen the anterior compression (if any).[9,10,13,15,16] These authors take into account the spinal canal widening due to fracture of posterior elements, which further makes the traction safer.

Instrumented versus uninstrumented fusion? Bhojraj and Shahane[1] described a case of spondyloptosis caused by obstetric trauma that caused a delayed neurological deficit. They managed it with corpectomy and autologous bone graft without instrumentation. Similarly, Shah and Rajshekhar[17] did similar uninstrumented fusion. But this resulted in long-term immobilization of the patient that can be avoided with the use of instrumentation. Instrumented fusion is preferred by most authors due to a more robust construct and early mobilization.

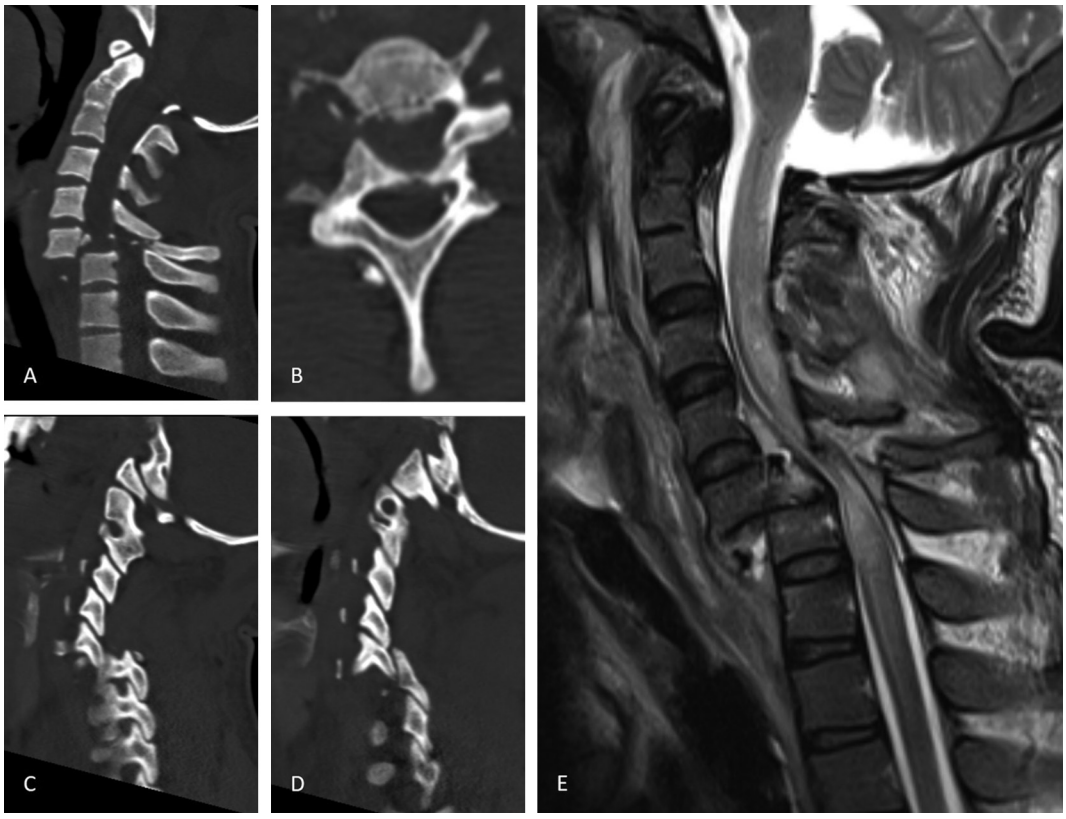

Fig. 3 (**A and B**) Preoperative noncontrast computed tomography cervical spine showing C6–7 spondyloptosis. (**C and D**) Both right and left facets have dislocated anteriorly. (**E**) Preoperative magnetic resonance imaging showing severe canal compromise with cord edema. There is a fragmented disc and hematoma posterior to C6 vertebral body.

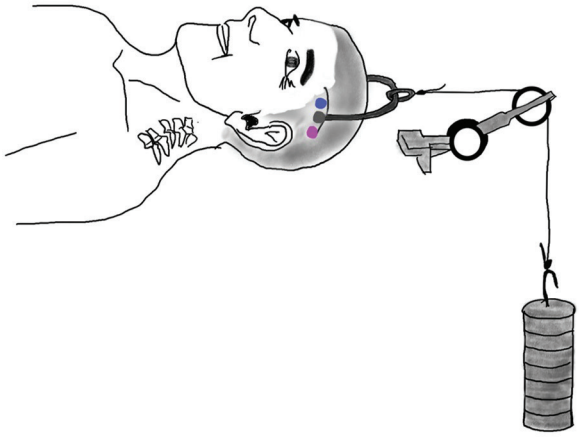

Fig. 4 Cervical traction using Gardner Wells tongs showing three markers just below the superior temporal line: gray on interaural line, blue 2 cm anterior, and pink 2 cm posterior to the interaural line. Traction at blue marker will cause extension of neck and flexion at pink marker.

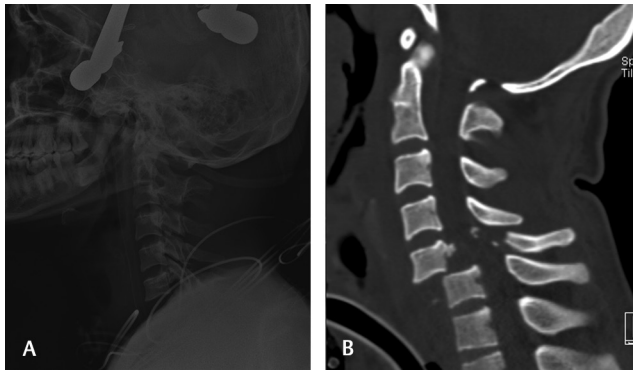

Fig. 5 Post-traction X-ray (**A**) and CT scan (**B**) showing incomplete reduction.

Single versus combined approach? A combined approach is recommended as it is a highly unstable fracture.[3,4,16] ►**Fig. 6** shows a 360-degree fusion in a case of cervical spondyloptosis. However, some authors have reported anterior only or posterior only approaches with good results.[1,6,9,12,17,18] Dahdaleh et al,[12] however, proposed that after initial anterior fusion, posterior fusion is done only if there is documented segmental instability on intraoperative fluoroscopy.

Which approach to do initially? An anterior approach is done initially if there is documented anterior compression on MRI and after reduction and anterior instrumented fusion, a posterior approach (360 degrees) is done. If anterior open reduction fails, a posterior approach is utilized to reduce the joint dislocation and after posterior instrumented fusion, anterior approach follows (540 degrees).[19] If there is no

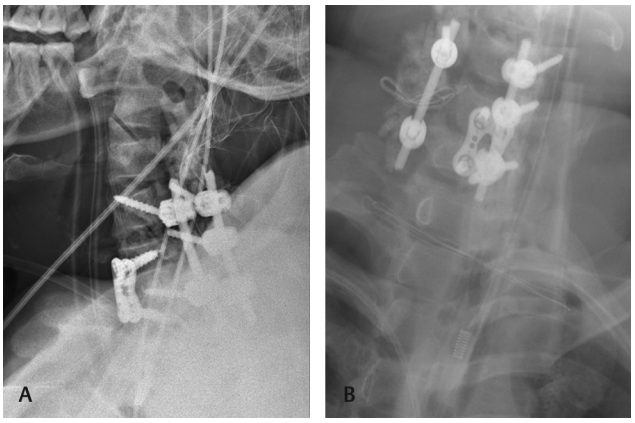

Fig. 6 The patient was approached anteriorly first as there was anterior compression (disc + hematoma). Postoperative X-ray showing C6–7 ACDF + plating with posterior C5–7 instrumented fusion.

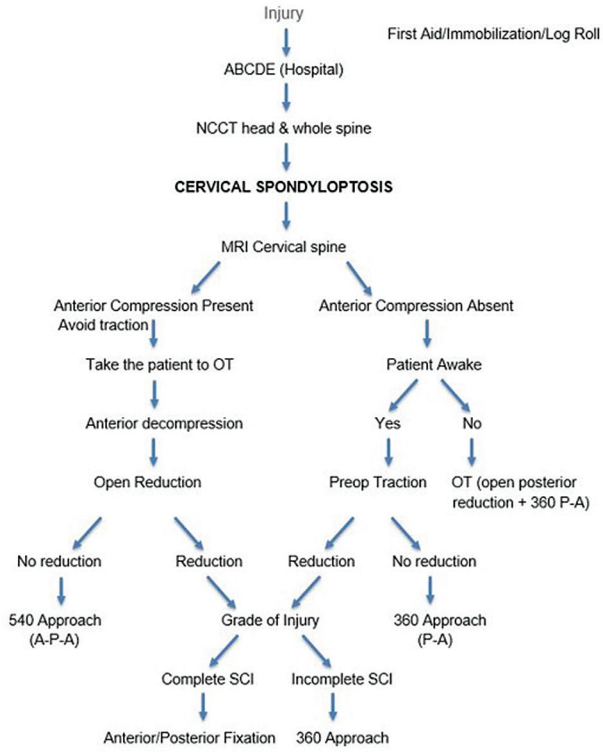

Fig. 7 Management of traumatic cervical spondyloptosis. MRI, magnetic resonance imaging; NCCT, noncontrast computed tomography; OT, operation theater.

anterior compression on MRI, a posterior approach is utilized first followed by an anterior approach (360 degrees). Failure of closed reduction without anterior compression warrants an initial posterior approach followed by anterior approach.[3,20]

Complete versus incomplete injury? In a patient with an incomplete injury, circumferential fusion is preferred under strict neuromonitoring.[16,19] Patients with complete injuries (ASIA-A) and/or associated comorbidities can be managed via anterior approach only as they may have unstable vitals and a dismal prognosis.[19]

The management algorithm has been summarized in ►**Fig. 7.**

Funding
None.

Conflict of Interest
None declared.

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