

## Spinal cord injuries - Instability is the issue-stabilization is the treatment

Issues related to spinal injury have been under discussion for several decades. Multiple forms of treatment that have been advocated range from surgical and nonsurgical drug treatment to stem-cell therapy.<sup>[1-7]</sup> All the known forms of treatment are focused to attempt to provide an opportunity of neurological recovery or at least some relief from otherwise crippling neurological symptoms and disabling deficits. Considering the high incidence of spinal cord injuries and its impact on the individual and the family and financial burden on the society, it is prudent that the scientific discussion on the subject and efforts to achieve the best clinical outcome continues with vigor.


The nature and timing of the surgical treatment is an intensely debated subject.<sup>[1]</sup> A uniform policy or strategy regarding the extent, need, and type of stabilization, decompression, and realignment continues to be discussed. It may be only fair to state that a defined pattern of treatment has not been identified, and discussion and confusion prevail on the subject.

Our observations on the subject suggest that the spinal bony canal is like a temple/mosque/church and the spinal cord is the deity. If the temple/mosque/church is broken or destroyed, a new construction can be initiated. However, if the deity itself is injured or harmed, there can be no therapeutic solution.

Our earlier observations, particularly in cases with spinal degeneration, included the fact that it is not neural compression or deformation that is the cause of neurological symptoms, but it is instability-related micro-injuries that initiate, propel, and manifest with neurological deficits.<sup>[8]</sup> It was discussed that instability is the primary issue and the so-called “pathological” issues as observed on radiological

examination that include osteophyte formation, ligamentum flavum buckling, and disc space reduction that eventually result in reduction in the spinal canal and neural foraminal size are secondary and naturally protective maneuvers.<sup>[9-18]</sup> More importantly, all these secondary issues have the potential for reversal after spinal segmental stabilization is achieved. It was observed that disc herniation or prolapse is either a cause or an effect of spinal instability.<sup>[19]</sup> Once stabilization is achieved, the disc is eventually resorbed. Ossification of the posterior longitudinal ligament and retro-odontoid ossification or pseudotumor is secondary to segmental instability.<sup>[20-23]</sup> Once stability is restored, there is a potential for spontaneous regression of the intrusion into the spinal canal. There are several other indicators of atlantoaxial and spinal instability, even when there is no radiological evidence of instability or of any kind of neural compression, distortion, or deformation. We labeled such spinal instability as “vertical” spinal instability and atlantoaxial axial instability as central or axial atlantoaxial instability. Chiari formation, syringomyelia, Klippel–Feil abnormality, assimilation of atlas, C2–3 fusion, platybasia, short neck, torticollis, bifid atlas, bifid axis, dorsal kyphoscoliosis, and a host of other so-called anomalies are natural protective maneuvers that are secondary to spinal instability, and all are potentially reversible following spinal stabilization.<sup>[24,25]</sup>

Essentially, it appears that injury results in instability of the spinal segment that causes neural affection and neurological deficits. The presence of neurological deficit following spinal injury is an indication of spinal instability even when there is no evidence of bone injury and when there are no clear radiological evidences of instability on static or dynamic imaging.<sup>[26]</sup> The presence of neurological deficit by itself is an indication of the use of a firm external spinal arthrodesis

Access this article online	
<b>Website:</b> <a href="http://www.jcvjs.com">www.jcvjs.com</a>	<b>Quick Response Code</b> 
<b>DOI:</b> 10.4103/jcvjs.jcvjs_24_22	

**Submitted:** 06-Feb-22  
**Published:** 09-Mar-22

**Accepted:** 22-Feb-22

This is an open access journal, and articles are distributed under the terms of the Creative Commons Attribution-NonCommercial-ShareAlike 4.0 License, which allows others to remix, tweak, and build upon the work non-commercially, as long as appropriate credit is given and the new creations are licensed under the identical terms.

**How to cite this article:** Goel A. Spinal cord injuries - Instability is the issue-stabilization is the treatment. *J Craniocerv Junction and Spine* 2022;13:1-3.

on an emergency basis and eventually the need for surgical stabilization.

Spinal cord injury and related moderate-to-severe neurological deficits without any evidence of radiological instability or fracture is a well-known and discussed issue. Pang and Wilberger identified the issue of “spinal cord injury without any radiological abnormality (SCIWORA)” in children and popularized the clinical sequence.<sup>[27]</sup> The presence of spinal spondylotic changes in a similar clinical and radiological picture in adults was labeled as spinal cord injury without computed tomography evidence of trauma (SCIWOCTET).<sup>[27-30]</sup> It is generally agreed that in the event of SCIWORA or SCIWOCTET, spinal injury is relatively minor, a relatively conservative treatment strategy can be adopted, and the ultimate clinical outcome is better. It is generally agreed that there may not be an indication of surgical stabilization in the absence of any radiological evidence of instability.

In general, the opinion is that a patient who is having neurological recovery from an initial severe deficit needs only clinical observation. In the absence of any radiological evidence of instability, the consensus heavily sways in favor of clinical observation. Our recent report identifies the significance of “instability” and the need for surgical treatment in cases with SCIWOCTET.<sup>[26]</sup> Identification and stabilization of the unstable spinal segments is the key and when appropriately executed a gratifying and early clinical improvement can be achieved. Such improvement can occur even in a patient who has partially recovered in neurological function after a severe injury.

The presence of neurological symptoms before injury in an adult is an indication of presence of instability before the event of trauma and its exaggeration following injury. The presence of radiological evidence of “degenerative spinal disease” that includes osteophyte formation, buckling of intervertebral ligaments, and disc space reduction is indicative of the fact that instability of the spine preexisted and was triggered further by injury. It appears that apart from neurological deficits related to direct cord injury, instability by itself can have a role in producing clinical manifestations and inducing symptoms and deficits. It appears that the presence of a neurological deficit following spinal injury is an indicator of spinal instability irrespective of radiological observations.<sup>[26]</sup> Stabilization that eventually results in arthrodesis of the involved spinal segments is the treatment. General observation is that spinal cord injury is focused on one spinal segment. However, in cases with SCIWOCTET, instability is generally in more than one segment, and often

atlantoaxial instability can also be associated and should not be missed.<sup>[15]</sup>

From our experience in the management of craniovertebral junction instability, it appears that more than realignment, it is strong stabilization of the spinal segments that is important. Realignment of spinal segments can be and probably should be achieved, but firm stabilization forms the basis of surgical treatment. Surgery that is focused on decompression of the neural structures by resection of the adjoining bones and ligaments must be avoided. Any attempt at removal of intramedullary hematoma and durectomy or cordectomy can have negative clinical implications.

The need for emergency or early surgery has been recommended.<sup>[26,31]</sup> Our observation is that early spinal stabilization needs to be done.<sup>[26]</sup> Once the clinical condition of the patient normalizes, stabilization using firm external arthrodesis is mandatory. Patient position and spinal torso needs to be firmly stabilized till the time surgery for stabilization is done.

No direct treatment of the injured or affected “deity” or spinal cord is necessary or possible. Rebuilding and restructuring of the abode of the deity should be done. Any attempt at manipulating or handling the injured spinal cord or the dura is unnecessary and probably harmful. The aim of surgery is stabilization and any form of bone or soft-tissue decompression has negative consequences.

The question about the need for stabilization of spinal segments in the presence of “complete” spinal cord section remains to be established. It is unclear if there is any benefit of mending the temple/mosque/church when the deity itself is lost. Fixation of the spinal segment in the absence of functioning muscles and nerves might serve little purpose. However, it appears that it is safer to err in favor of stabilization in this situation. Mobilization of the spine for rehabilitation can be done better in a stable than in an unstable spinal segment.

**ATUL GOEL<sup>1,2,3</sup>**

<sup>1</sup>Department of Neurosurgery, Lilavati Hospital and Research Center, <sup>2</sup>Department of Neurosurgery, R. N Cooper Hospital and Medical College, <sup>3</sup>Department of Neurosurgery, Bombay Hospital Institute of Medical Sciences, Mumbai, Maharashtra, India

**Address for correspondence:** Prof. Atul Goel, Department of Neurosurgery, Lilavati Hospital and Research Center, Bandra, Mumbai, Maharashtra, India.  
E-mail: atulgoel62@hotmail.com

## REFERENCES

1. Fehlings MG, Vaccaro A, Wilson JR, Singh A, Cadotte DW, Harrop JS, *et al.* Early versus delayed decompression for traumatic cervical spinal cord injury: Results of the Surgical Timing in Acute Spinal Cord Injury Study (STASCIS). *PLoS One* 2012;7:e32037.
2. Yelamarty PK, Chhabra HS, Vaccaro A, Vishwakarma G, Kluger P, Nanda A, *et al.* Management and prognosis of acute traumatic cervical central cord syndrome: Systematic review and Spinal Cord Society-Spine Trauma Study Group position statement. *Eur Spine J* 2019;28:2390-407.
3. Roy-Camille R, Saillant G, Laville C, Benazet JP. Treatment of lower cervical spinal injuries – C3 to C7. *Spine (Phila Pa 1976)* 1992;17:S442-6.
4. Brodkey JS, Miller CF Jr., Harmody RM. The syndrome of acute central cervical spinal cord injury revisited. *Surg Neurol* 1980;14:251-7.
5. Fehlings M, Sekhon L, editors. Cellular, Ionic and Biomolecular Mechanisms of the Injury Process. Chicago: American Association of Neurologic Surgeons; 2000. p. 33-50.
6. Tator C, Fehlings M. Review of the secondary injury theory of acute spinal cord trauma with emphasis on vascular mechanisms. *J Neurosurg* 1991;75:15-26.
7. Goel A. Stem cell therapy in spinal cord injury: Hollow promise or promising science? *J Craniovertebr Junction Spine* 2016;7:121-6.
8. Goel A. Not neural deformation or compression but instability is the cause of symptoms in degenerative spinal disease. *J Craniovertebr Junction Spine* 2014;5:141-2.
9. Goel A, Shah A. Facetal distraction as treatment for single- and multilevel cervical spondylotic radiculopathy and myelopathy: A preliminary report. *J Neurosurg Spine* 2011;14:689-96.
10. Goel A. Facet distraction spacers for treatment of degenerative disease of the spine: Rationale and an alternative hypothesis of spinal degeneration. *J Craniovertebr Junction Spine* 2010;1:65-6.
11. Goel A. Vertical facetal instability: Is it the point of genesis of spinal spondylotic disease? *J Craniovertebr Junction Spine* 2015;6:47-8.
12. Goel A. Is instability the nodal point of pathogenesis for both cervical spondylotic myelopathy and ossified posterior longitudinal ligament? *Neurol India* 2016;64:837-8.
13. Goel A. Only fixation for cervical spondylosis: Report of early results with a preliminary experience with 6 cases. *J Craniovertebr Junction Spine* 2013;4:64-8.
14. Goel A, Dandpat S, Shah A, Rai S, Vutha R. Muscle weakness-related spinal instability is the cause of cervical spinal degeneration and spinal stabilization is the treatment: An experience with 215 cases surgically treated over 7 years. *World Neurosurg* 2020;140:614-21.
15. Goel A. Role of subaxial spinal and atlantoaxial instability in multisegmental cervical spondylotic myelopathy. *Acta Neurochir Suppl* 2019;125:71-8.
16. Goel A, Vutha R, Shah A, Patil A, Dhar A, Prasad A. Cervical spondylosis in patients presenting with “severe” myelopathy: Analysis of treatment by multisegmental spinal fixation – A case series. *J Craniovertebr Junction Spine* 2019;10:144-51.
17. Goel A, Vaja T, Shah A, Rai S, Dandpat S, Vutha R, *et al.* Outcome of osteophytes after only-fixation as treatment for multilevel cervical spondylosis – A minimum of 12 months follow-up. *World Neurosurg* 2021;146:e876-87.
18. Goel A, Dharurkar P, Shah A, Gore S, Bakale N, Vaja T. Facetal fixation arthrodesis as treatment of cervical radiculopathy. *World Neurosurg* 2019;121:e875-81.
19. Goel A. Is disc herniation “secondary” to spinal instability? Is it a protective natural response? *J Craniovertebr Junction Spine* 2021;12:213-5.
20. Goel A, Grasso G, Shah A, Rai S, Dandpat S, Vaja T, *et al.* “Only spinal fixation” as surgical treatment of cervical myelopathy related to ossified posterior longitudinal ligament: Review of 52 cases. *World Neurosurg* 2020;140:556-63.
21. Goel A. Ossification of the posterior longitudinal ligament: Analysis of the role of craniovertebral and spinal instability. *Acta Neurochir Suppl* 2019;125:63-70.
22. Goel A, Darji H, Shah A, Prasad A, Hawaldar A. Retro-odontoid and retro-C2 body pseudotumor, pannus, and/or cyst. A study based on analysis of 63 cases. *World Neurosurg* 2021;151:e170-7.
23. Goel A. Retro-odontoid mass: An evidence of craniovertebral instability. *J Craniovertebr Junction Spine* 2015;6:6-7.
24. Goel A. A review of a new clinical entity of ‘central atlantoaxial instability’: Expanding horizons of craniovertebral junction surgery. *Neurospine* 2019;16:186-94.
25. Goel A. Central or axial atlantoaxial instability: Expanding understanding of craniovertebral junction. *J Craniovertebr Junction Spine* 2016;7:1-3.
26. Goel A, Lunawat A, Shah A, Dandpat S, Hawaldar A, Darji H, *et al.* Clinical outcome following multisegmental cervical spinal fixation in patients who recovered partially following injury. *J Craniovertebr Junction Spine* 2021;12:216-22.
27. Pang D, Wilberger JE Jr. Spinal cord injury without radiographic abnormalities in children. *J Neurosurg* 1982;57:114-29.
28. Martinez-Perez R, Munarriz PM, Paredes I, Cotrina J, Lagares A. Cervical spinal cord injury without computed tomography evidence of trauma in adults: Magnetic resonance imaging prognostic factors. *World Neurosurg* 2017;99:192-9.
29. Machino M, Ando K, Kobayashi K, Ota K, Morozumi M, Tanaka S, *et al.* MR T2 image classification in adult patients of cervical spinal cord injury without radiographic abnormality: A predictor of surgical outcome. *Clin Neurol Neurosurg* 2019;177:1-5.
30. Asan Z. Spinal cord injury without radiological abnormality in adults: Clinical and radiological discordance. *World Neurosurg* 2018;114:e1147-51.
31. Qi C, Xia H, Miao D, Wang X, Li Z. The influence of timing of surgery in the outcome of spinal cord injury without radiographic abnormality (SCIWORA). *J Orthop Surg Res* 2020;15:223.