

Indicators of spinal instability in degenerative spinal disease

Our earlier articles identify spinal “instability” as the nodal point of pathogenesis of a range of commonly encountered clinical issues related to the spinal column that include degenerative spondylosis.^[1-7] Instability spawns several natural responses in the form of musculoskeletal and neural alterations, all ultimately aimed to protect the neural structures.

A large proportion of muscle bulk involved in spinal movements is located in the “back” or posterior aspect of the torso of the body, and their fulcrum of activity is focused at the facet articulation. A relatively thin sheath of muscles is located in the anterior spinal column in the vicinity of the intervertebral discs. Weakness of the muscles related to “old” age, disuse, abuse, or injury results in “vertical” instability of the spine that is manifested at the facet articulation in the form of listhesis of facet of the rostral vertebra over the facet of caudal vertebra. Standing human posture in itself puts a life-long strain on the muscles of the spine and predisposes them to potential “age-related” fatigue. While the facet articulation is the point of activity of the muscles, the disc masters all the movements. Disc functions as an opera conductor who regulates the opera without lifting a single musical instrument in hand.^[8] While muscles are the motor engines of the body vehicle, the disc is like air in the tires. For the human “vehicle” to run, both the motor engine and tires need to work in harmony. Like motor engines, the muscles fuel movement, and like the tires of the motor vehicle, the human disc is tuned to coordinate all activities and contribute to stability and mobility.

The test of the machine (human body) is the satisfaction it gives you. There isn't any other test. If the machine produces tranquility it's right. If it disturbs you it's wrong until either the machine or your mind is changed.

- Robert Pirsig

Like engines require movement, maintenance, and oiling or the gears rust and battery dies, so also the human body maintenance is in the form of sustained physical activity and muscle exercise.

As muscle weakness is more often generalized and is the prime cause of spinal instability, in a chronic situation, rather than being at a single level, such instability is usually at multiple spinal segments. Vertical spinal instability leading to potential, subtle, or manifest retrolisthesis of facets is the primary point of origin of neurological symptoms, morphological alterations, and radiological manifestations. Each of these consequences of spinal instability may be present together or discretely.^[9] Clinical symptoms may be present even in the absence of morphological and radiological alterations.^[10] The presence of radiculopathy and/or myelopathy is indicative of spinal instability even in the absence of radiological evidences of the nerve root/spinal cord compression by osteophytes/disc bulge or ligamentum flavum buckling. There may be no symptoms despite the presence of radiological evidences or morphological consequences of spinal instability.

In essence, one has to look beyond the radiological image. It is not neural compression or deformation that is the cause of clinical symptoms, but it is an instability-related neural response that causes symptoms.^[11] The exact cause of initiation and progression of symptoms appears to be a dynamic phenomenon, and repeated microtrauma appears to play a role. Vertical “doubling” or longitudinal reduction in spinal cord height can be a cause of symptoms related to myelopathy. It could be that the “nerve supply” to the articular cavity initiates a response that is relayed to the nerve roots and to the spinal cord. A significant radiological

Access this article online	
Website: www.jcvjs.com	Quick Response Code 
DOI: 10.4103/jcvjs.JCVJS_115_20	

Submitted: 19-Jul-20 **Accepted:** 20-Jul-20
Published: 14-Aug-20

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How to cite this article: Goel A. Indicators of spinal instability in degenerative spinal disease. J Craniovert Jun Spine 2020;11:155-6.

consequence can be intra-axial spinal cord changes with or without association of so-called “compressive” elements. Such cord changes can be due to vertical cord “buckling.”

Vertical reduction in the spinal column height results in buckling of intervertebral ligaments that include ligamentum flavum and posterior longitudinal ligament and reduction in the disc space height. “Osteophyte” includes a ligamentous component of buckled posterior longitudinal ligament, bone component, and disc bulge related to disc space reduction. The overall effect of vertical spinal instability and its secondary consequences include a reduction in the spinal canal and root canal space.

Instability is the basis of problems and stabilization is the treatment. Identification of the levels of spinal instability is the crucial issue in deciding the spinal segments that need stabilization.^[12] The presence of osteophytes, reduction of the intervertebral disc space, and evidence of ligamentum flavum buckling are indicative of an unstable spinal segment irrespective of the presence of clinical symptoms. Clinical radicular symptoms can indicate the level of spinal instability even in the absence of morphological alterations.

Physical assessment of facet articulation during surgery can “finally” confirm the unstable spinal segment. Assessment of instability by manual manipulation of bones can indicate the presence or absence of an unstable spinal segment. Such manipulation can be done in segments adjoining the suspected unstable spinal levels on the basis of clinical and radiological guides. Open facet articulation and osteophytes in the vicinity of facet articulation can indicate segmental instability.^[12] Ignoring an unstable spinal segment just because there are no morphological associations of osteophytes or ligamentum flavum-related compression on the radiological image seems to be an important cause of failed surgical procedure and adjacent segment issues following spinal surgery.

Moderately severe or severe cervical myelopathy is “frequently” associated with “central” or “axial” atlantoaxial instability.^[13,14] Ignoring atlantoaxial instability can be a cause of failure of surgical treatment. This is particularly true in “old” age group patients.

In acute instability that is related to trauma or injury that leads to herniation of the intervertebral disc, there can be spasm in the muscles of the nape of the neck or of the back. Despite the presence of instability, the facets may be firmly

approximated. In such cases, it is crucial to identify the site of disc herniation and the spinal level affected so that stabilization of the correct spinal segment is done.

The doctor of the future will give no medicine, but will instruct his patients in care of the human frame, in diet and in the cause and prevention of disease.

- Thomas Edison

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