

# Degenerative Cervical Spondylosis- Is Instability the Primary Point of Pathogenesis?

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## Commentary

Degenerative spinal 'disease' is a frequent cause of radiculopathy and myelopathy and can lead to disabling symptoms and neurological deficits. The issue has been under extensive discussion for over a century. Disc degeneration and 'age-related' loss of its water content has been universally agreed to be the nodal point of pathogenesis that leads to a cascade of pathological events that are clubbed under the term 'spinal degenerative spondylosis'. The essential elements in the degenerative process are intrusion into the spinal canal by 'pathological' thickening of posterior longitudinal ligaments (osteophytes) and ligamentum flavum. The entire process leads to reduction in the spinal canal or root canal space slated for traverse of neural tissues resulting in spinal cord (myelopathy) or root compressive symptoms (radiculopathy).

Radiological imaging has improved over the years and a circumferential visualization of the entire spinal bone and soft tissue architecture is now vividly possible. This is in contrast to plain radiography (or X-Rays) that essentially presented a profile imaging of spine. Disc space changes were vividly identified on plain X-rays, whilst other bone and soft tissue structures could only be 'imagined'. This was probably the reason that identification and evaluation of the spondylotic disease was disc-centric for several decades.

Spinal or root canal stenosis has been conventionally identified to be the net result of spinal degeneration. The treatment is consequently focused on 'decompression' of the neural structures by removal of the offending bones, ligaments and osteophytes and making space for their free and unhindered 'breathing' of the neural structures. Removal of the 'degenerated' disc material is considered by most to be an essential component of the decompressive surgery. Some authors have discussed the need for single or multi-level corpectomy to achieve 'wide' and 'long' decompression. The general opinion is that removal of large or small parts of bone and soft tissues can have a de-stabilizing effect on the spine and hence several surgeons advocate the need for stabilization of the spine following the decompressive operation.

Facets are the site of initiation and conduct of most spinal movements. In the entire spine, facets are the sites of movement [1]. Odontoid process in the craniovertebral junction and disc in the rest of the spine are the brain behind all the movements [2]. Disc and odontoid process are like orchestra conductors wherein they direct the movements that are actually conducted by the facets [1]. In the year 2010, we speculated that instability of the spine manifested at the site of its maximal movements, namely the facets, is the primary site of pathogenesis in degenerative spinal disease [3,4]. Longstanding or lifelong standing position leads to strain on the muscles of the back of the spine. The muscles not only have a role to play in the extension and other movements of the neck, but also to keep the vertebral segments apart. Misuse or disuse of the muscles leads to weakness of muscles that is manifested by instability of the spine at the facets. The oblique profile of the facets results in retrolisthesis and has a telescoping effect on the spinal segments. The reduction in vertical height of a person during old age is an effect of retrolisthesis of multiple spinal segments. Vertical instability or vertical collapse of the spine forms the basis of degenerative spinal disease [5]. Buckling of the ligamentum flavum and buckling of the posterior longitudinal ligament are secondary to vertical spinal instability. Osteophyte formation appears to be secondary to

buckling of posterior longitudinal ligament. It is unclear but it appears that disc space reduction is also a secondary effect to vertical facet instability. Essentially the theory suggests that instability of the spine rather than intrusions of the ligaments, bones, osteophytes or disc are the primary issue in the pathogenesis. The rest of the bone and soft tissue changes are secondary and probably 'protective' in nature [6,7].

On the basis of this hypothesis, we proposed that distraction of the facets and their fixation-arthrodesis reverses all the effects listed in as pathological in spinal degeneration [8-11]. Introduction of 'Goel facet spacer' resulted in an immediate increase in the spinal and root canal dimensions and also affected un-buckling of the ligamentum flavum and posterior longitudinal ligaments. We also identified that the distraction of the facets also resulted in an increase in the disc space height and an increase in its water content. Distraction, reduction and fixation of the spine reversed all the known consequences of degenerative spine and results in remarkable and lasting clinical improvements [8-11]. The introduction of the spacer in the intra-articular spacer is essentially intended to reverse the retrolisthesis and restore the inter-facet height. The intra-articular spacers ultimately aim to achieve arthrodesis in distracted position and to restore sagittal spinal balance. The remarkable recovery in the neurological disability can be observed in the immediate post-operative period. Impaction of the spacer into the joint can have a kyphotic effect if the spacer is larger than the optimum size. The relevance of use of spacers in a kyphotic cervical spine needs to be analysed on the basis of further clinical experience.

As we mature in our understanding of the issue of spinal degeneration, we realize that the neurological symptoms or deficits are unrelated to neural deformation but repeated microtrauma as a result of instability is the cause of symptoms. The neural tissues are highly resilient and can tolerate remarkable loss of substance and deformation. This fact can be observed in situations with chronic benign tumors and syringomyelia where the cord substance or the thickness of the neural structures is reduced to thin filaments, but the functionality of the neural tissue is only marginally affected. Essentially it means that there is no need to remove the osteophytes, thickened ligaments or protruding disc bulge to affect restoration of the cord shape, it is essential to stop the abnormal movements by stabilization. We have now realized that 'only fixation' of the facets or the site of spinal movements is an ideal form of treatment for degeneration of spine [12-14]. We prefer transarticular facet fixation [15,16]. This technique is safe, quick and rather straightforward and effective.

In general, degenerative cervical spinal disease is located in the C5-6

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or C6-7 region. Less commonly higher levels like C3-4 and C4-5 are also involved. In cases with multi-level spinal degeneration, craniovertebral junction is generally excluded from the umbrella of spinal degeneration. We have recently identified that atlantoaxial instability is a frequent association with multi-level spinal degeneration [17]. Atlantoaxial joint is the most mobile joint of the body and instability at this joint can be frequent. In cases with multi-level spinal degeneration it is highly unlikely that atlantoaxial joint is spared of instability when the facets of rest of the spine are unstable. The atlantoaxial instability can be identified by the mal-alignment of the atlantoaxial facets, as recently discussed by us. We currently believe that atlantoaxial instability is almost always associated with multi-level spinal degeneration.

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