Mini Review
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Spino-Pelvic sagittal alignment and spondylolisthesis

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The normal spine consists of lordotic curves in the cervical and lumbar regions with a junctional kyphotic curve in the thorax. Historically, sagittal spinal alignment has been based primarily on this alignment of the thoracic and lumbar spinal segments. Exaggerations or deficiencies in the respective lordotic and kyphotic segments lead to sagittal imbalance or malalignment. Recent literature has elucidated that a complete assessment of sagittal alignment must account for not only thoracolumbar curvature, but also pelvic alignment and presence of spondylolisthesis as well. Dobousset recognized early the importance of the pelvis and referred to it as the sixth lumbar vertebrae.[1] Spondylolisthesis, or sagittal subluxation of vertebral bodies, must be considered in the context of global sagittal alignment in order to understand disease prognosis and treatment options.

A fundamental understanding of the principles of sagittal balance is necessary to achieve clinical success when treating spinal disorders. The sagittal vertical axis (SVA) is used to evaluate the position of the head with respect to the normal center of gravity. The SVA, as measured from the radiographic C7 plumb line drawn vertically down from the center of the C7 vertebral body, should intersect the poster superior corner of S1. Alterations in the SVA have direct effects on outcome; positive balance correlates linearly with worse outcomes.[2,3] Additionally, Harroud has also shown worse outcomes with high-grade spondylolisthesis.[4]

The Spinal Deformity Study Group proposed a classification to assess the sagittal spino-pelvic alignment of patients with spondylolisthesis and understand its influence on treatment paradigms.[5] This system takes into account not only the spondylolisthesis slip grade, but also overall spinal alignment and pelvic incidence (PI). PI is a fixed anatomic parameter defined by the angle of the sacral end plate and the spatial orientation of the femoral head to the sacrum. PI determines pelvic orientation and is directly related to the degree of lumbar lordosis. Subgroups of spondylolisthesis were formed based on three parameters: slip grade, SVA, and PI. Slip grade was defined as either low grade (<50%) or high grade (>50%) slip, while PI was separated into <45º, 45-60º, and >60º groups.

Global sagittal balance was defined as SVA within 5cm of the poster superior corner of S1. By combining these parameters, the authors expanded upon the original Meyerding classification by defining various subcategories of spondylolisthesis based on severity and risk of progression. The authors suggested that globally unbalanced high-grade slips may be better managed with surgical reduction and stabilization that their well balanced counterparts.

Various other studies have examined the interplay between spinopelvic alignment and spondylolisthesis. A retrospective analysis of a large cohort of patients, 24% of patients with degenerative spondylolisthesis were found to have sagittal anterior misalignment. Additionally, these patients had higher average PI as well as significantly lower LL. Through radiographic analysis, Hanson et al.[6] showed that patients with spondylolisthesis had significantly higher PI. Moreover, patients with high-grade spondylolistheses had higher PI than patients with low-grade slips.

In a more clinical setting, Wang et al.[7] successfully correlated symptomatology in isthmic spondylolisthesis with various spinopelvic parameters, especially sacral slope and sacro-femoral vertical distance. Surgical correction of deformity in adult spondylolisthesis can affect these spinopelvic parameters and sagittal balance. Park et al showed that during surgical correction of adult isthmic spondylolisthesis with circumferential fusion, restoration of intervertebral disc height leads to improvement of lumbar lordosis and overall sagittal alignment.[8]

The relationship of the pelvis to the spine has previously been overlooked, and its importance in sagittal balance has been underestimated. There is a crucial interplay between structural pelvic features, spinopelvic parameters, and sagittal alignment in both normal volunteers and patients with spondylolisthesis. Although satisfactory outcomes have been reported for multiple surgical techniques in the management of spondylolisthesis, restoration of disc height, lumbar lordosis, and global sagittal balance may improve clinical recovery rates and prevent future junctional problems.[9,10]

Acknowledgments

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Conflicts of interest

None.

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