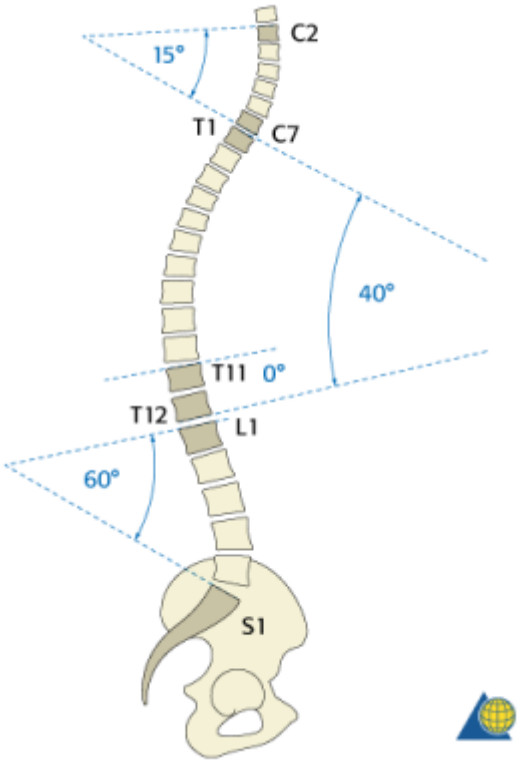
Sagittal alignment

see also Coronal Alignment



The optimal goal of a truly balanced spine is to maintain the head over the femoral heads. When spinal imbalance occurs, the human body reacts through various compensatory mechanisms to maintain the head over the pelvis and to retain a horizontal gaze. Historically, deformity correction has focused on correcting scoliosis and preventing scoliotic curve progression. Following substantial correction of a spinal deformity, reciprocal changes take place in the flexible segments proximal and distal to the area of correction. Restoration of lumbar lordosis following surgery to correct a thoracolumbar deformity induces reciprocal changes in T1 slope, cervical lordosis, pelvic shift, and lower extremity parameters. Patients with cervical kyphotic deformity exhibit different patterns of reciprocal changes depending on whether they have head-balanced or trunk-balanced kyphosis. These reciprocal changes should be considered to in order to prevent secondary spine disorders. It is important to evaluate the global spinal alignment to assess postoperative changes [1)]

Whole-spine sagittal alignment, including cervical lordosis, thoracic kyphosis, and lumbar lordosis, is important for maintenance of horizontal gaze and minimization of energy consumption in the normal state [2) 3) 4)] , and there is a close relationship between whole-spine sagittal alignment and pelvic alignment in maintaining global sagittal balance.

Sagittal alignment, often misrepresented as sagittal balance, describes the ideal and “normal” alignment in the sagittal plane, resulting from the interplay between various organic factors. Any pathology that alters this equilibrium instigates sagittal malalignment and its compensatory mechanisms. As a result, sagittal malalignment is not limited to adult spinal deformity; its pervasiveness extends through most spinal disorders. While further research is developing, the

literature reports clinically relevant radiographic parameters that have significant relationships with patient-reported outcomes [5].

A study demonstrates that sagittal alignment of the human spine and pelvis in a standardized standing position is highly variable in different individuals. For example, in a cohort of 160 normal subjects, the angle of the superior endplate of S1 with respect to the horizontal axis varied between 20° and 65°, the angle of global lumbar lordosis varied between 41° and 82°, and the number of vertebral bodies in a lordotic orientation varied from 1 to 8. These data suggest that the widely accepted generalization that the spine is kyphotic between T1 and T12 and lordotic between L1 and L5 may be overly simplistic. The correlations between the various parameters of lumbar and pelvic alignment indicate that characteristics of the lumbar lordosis are most dependent on the orientation of the sacral slope and the pelvis. The upper arc of lumbar lordosis remains relatively constant, with an average value of approximately 20° in all proposed types of sagittal alignment. In contrast, the lower arc of lordosis is the most important determinant of the global lordosis: lordosis tilt angle, position of the apex, and number of lordotic vertebrae. A sacral slope less than 35° and a low pelvic incidence are associated with a relatively flat, short lumbar lordosis. A sacral slope greater than 45° and a high pelvic incidence are associated with long, curved lumbar lordosis. This reciprocal association between the orientation of the sacrum and the characteristics of the lumbar lordosis is an important component of overall sagittal alignment [6].

Cervical sagittal alignment

Cervical sagittal alignment

Commentaries

Pennington Z, Sciubba DM. Commentary: Uncertainty in the Relationship Between Sagittal Alignment and Patient-Reported Outcomes. Neurosurgery. 2019 Jul 24. pii: nyz276. doi: 10.1093/neuros/nyz276. [Epub ahead of print] PubMed PMID: 31340018 [7].

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Pennington Z, Sciubba DM. Commentary: Uncertainty in the Relationship Between Sagittal Alignment and Patient-Reported Outcomes. Neurosurgery. 2019 Jul 24. pii: nyz276. doi: 10.1093/neuros/nyz276. [Epub ahead of print] PubMed PMID: 31340018.