

Sp 22: What are the radiological parameters for reliably describing instability and the value of instability scores for planning surgical stabilisation in spinal tuberculosis?

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Recommendation:

Based on available data, kyphosis greater than 30 degrees, vertebral body loss or destruction exceeding 1 to 1.5, involvement of three or more contiguous vertebrae, pan-vertebral involvement, junctional location, and the presence of 'spine-at-risk' signs are reliable radiological parameters for identifying instability in thoracolumbar spinal tuberculosis. In craniovertebral junction tuberculosis, it is considered unstable if there is migration of the tip of the odontoid above the McRae line or the presence of atlantoaxial instability. Cervical kyphosis greater than 30 degrees is the only documented radiological parameter that defines instability in the subaxial cervical spine. Spinal instability is a significant indication for surgical stabilization. Scoring systems to assess stability can aid surgical decision-making and establish universally applicable, consistent treatment guidelines.

Level of Evidence: Moderate

Delegate Vote:

Rationale:

Spinal instability constitutes an absolute indication for surgical management in TB spine. Over the years, various researchers have defined different criteria for spinal instability in TB. A recent systematic review evaluated parameters used by various researchers and shed light on several lacunae in the current literature to reliably define instability in TB spine¹. There is no clear expert consensus on what constitutes instability in TB spine.

Radiographic Parameters for Instability in Thoraco-Lumbar Spine TB

Kyphotic deformity in TB spine is an important indication for surgical stabilization. Progressive failure of the anterior column due to the disease process itself and repetitive loading eventually leads to the failure of a healthy posterior column, resulting in spinal instability. Several authors have used varied degrees of severity of kyphosis as the cutoff for spinal fixation. Jutte et al² and Mehta et al³ have used 30 degrees, whereas Nene et al⁴ and Chandra et al⁵ have considered 40 degrees of pretreatment kyphosis as a cut off for spinal fixation. Jain et al⁶ on the other hand have recommended a predicted kyphotic deformity of 60 degrees calculated at the start of the treatment using Rajasekaran et al⁷ proposed formula $Y = a + bx$ (where Y represents the final predicted kyphosis, 'a' and 'b' are constants and x represents the initial loss of vertebral height) in the thoracic and thoraco-lumbar spine as an indication for surgery. Rajasekaran et al⁸ also suggested a pre-treatment kyphosis of 30 degrees, especially in the paediatric population, as an indication for surgical stabilization.

Involvement of all three columns of the vertebrae in the form of pan-vertebral disease or facet joint destruction by the disease itself has been used to define instability. Pan-vertebral involvement presenting as scoliosis or severe kyphosis in radiographs indicates instability in

the form of lateral or antero-posterior translation^{3, 9-11}. Involvement of facet joints as evident in CT/MRI findings or facet joint subluxation or dislocation indicates pan-vertebral disease and spinal instability¹². Rajasekaran¹³ analysed the natural history of kyphosis in TB spine in the paediatric population and documented four 'spine at risk' signs including dislocation of the facets, posterior retropulsion of the diseased fragments, lateral translation of the vertebrae in the anteroposterior view and toppling of the superior vertebra. Presence of two or more signs signified instability in children.

Junctional regions of the spine are subject to translational forces and involvement of the junctional region is considered as a sign of instability. Spinal TB with vertebral destruction at the junction between a rigid and a flexible region of spine, such as the cervico-dorsal, dorso-lumbar, or lumbo-sacral regions, is at higher risk of displacement, instability, and deformity progression under normal axial or rotatory movements^{8, 10}.

Multilevel contiguous TB spine is also considered an indicator of instability. The number of vertebrae involved or destroyed at the beginning of the treatment has been shown to correlate with the final kyphosis in the natural history of progression in the TB spine and, therefore, indirectly affect spinal stability. Jain et al⁶ considered involvement of three or more vertebrae or destruction of more than one and a half vertebrae as 'long-segment disease' and indicators of spinal instability. Rajasekaran¹³ described different types of collapse and subsequent restabilization of vertebrae based on the amount of vertebral body destruction. Vertebral body loss of more than 0.75 was considered an indicator of facet joint disruption and unstable spine. Jutte et al² described unstable spine as involvement of more than two vertebrae, whereas in a paradiscal disease destruction of more than 50% of both the involved vertebrae was considered unstable by Djientcheu et al¹⁴.

Radiographic Parameters for Instability in Cervical Spine TB

Atlantoaxial instability or superior migration of the tip of the odontoid above McRae or McGregor line were documented as instability determinants in craniovertebral junction TB. Chaudhary et al¹⁵ defined anteroposterior instability in C1–C2 TB as migration of the C1 posterior arch anterior to the extrapolated spino-laminar line. Vertical instability (basilar impression) as migration of the tip of the odontoid above the McRae line. In cases with odontoid destruction, vertical instability is considered if the projected tip of the odontoid process was above the McRae line in addition to gross destruction of the lateral weight-bearing columns (lateral mass of the atlas and the occipital condyles). Bapat et al¹⁶ considered an atlanto-dens interval more than 8 mm or migration of the odontoid tip 4 mm above the McGregor line as unstable. Reducible atlantoaxial instability in the form of subluxation or dislocation, lateral subluxation or superior migration of dens, and varying degree of bone destruction of atlas or concomitant involvement of occipital condyle have all been documented consistently as the instability sign in C1-C2 TB¹⁵⁻¹⁸.

With respect to the subaxial spine TB, literature defining instability is rather limited. Cervical kyphosis of 30 degrees was found to be the only criteria indicative of instability¹⁹. Extrapolating from the criteria of the thoracolumbar spine, it can be stressed that facet involvement by disease itself, pan vertebral disease, facet subluxation, or dislocation with cervical kyphosis, all can be signs of instability.

Spine Instability Scores in Spine TB

Scoring systems to define instability and guide surgical decision making in spinal pathologies such as trauma and spinal metastasis are well documented in the literature and widely adopted in clinical practice. Similarly, scoring systems to determine the stability in spinal tuberculosis will aid clinicians in surgical decision making and will help establish universally applicable consistent treatment guidelines. Over the recent years, several authors have developed reliable and valid scoring systems for predicting instability in patients with spine TB²¹⁻²³.

Ahuja et al²¹ developed Tuberculosis Spine Instability Score (TSIS), a comprehensive scoring system integrating demographic, anatomical, clinical and radiological factors aimed at predicting instability and determining indication for surgical stabilisation in patients with TB spine, with no or little neurological deficit. Score less than 7 indicates a stable spine, between 7 and 10 denote “impending instability” and score greater than 10 indicate unstable spine and the potential need for surgical stabilisation.

Rajasekaran et al²² developed a simple objective scoring system for predicting instability in spinal TB through robust scientific methodology and multi-national expert panel. Factors directly responsible for determining deformity progression, instability or impending instability—young age at presentation, junctional involvement, the severity of Kyphosis, vertebral body loss, and presence of spine at risk signs were considered as the 5 main components of the scoring system. Score of <2 is considered stable, 2 is potential instability and 3 or above is definite instability.

Pithwa et al²³ have hypothesized that widely used Spinal Instability Neoplastic Score (SINS) can be extrapolated for Spinal TB since the process of bone destruction in infection is more akin to that in neoplasm than to that of trauma, and found the SINS score to be a useful objective decision-making tool in assessing the need for surgical intervention. Similarly, Schömig et al²⁴ proposed Spinal Instability Spondylodiscitis Score (SISS) through expert consensus based on the pre-existing SINS. All these spinal TB instability objective scores have shown to be reliable and valid in detecting unstable lesions in spinal TB and can be a helpful tool in surgical decision making.

Conclusion:

Kyphosis >30°, vertebral body loss or destruction of more than 1 -1.5, involvement of three or more contiguous vertebra, pan-vertebral involvement, junctional location and presence of ‘spine-at-risk’ signs are the reliable radiological parameters for describing instability in thoracolumbar spinal tuberculosis. Migration of the tip of the odontoid above the McRae line or atlantoaxial instability are considered as determinants for instability in the craniovertebral junction tuberculosis. Literature defining instability in subaxial cervical spine is rather limited and cervical kyphosis > 30 ° is the only radiological parameter that has been documented to define instability in subaxial cervical spine. Spinal instability is an important indication for surgical stabilisation and scoring systems to determine the stability in spinal tuberculosis will aid clinicians in surgical decision making and would help establish universally applicable consistent treatment guidelines.

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