

Interbody Fusion in Pyogenic Thoracolumbar Spondylodiscitis: Current Concepts in Diagnosis and Surgical Management ; A Review

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Abstract

Background: Pyogenic spondylodiscitis is a destructive spinal infection involving the intervertebral disc and adjacent vertebral endplates. Thoracolumbar involvement may progress from persistent pain and local infection to vertebral destruction, segmental instability, deformity, abscess formation, and neurological compromise. Although antimicrobial therapy and immobilization remain fundamental components of treatment, selected patients require surgical debridement and reconstruction.

Aim: To review the pathophysiology, clinical diagnosis, imaging assessment, treatment decision-making, and the rationale and available approaches for interbody fusion in pyogenic thoracolumbar spondylodiscitis.

Conclusion: Interbody fusion is an important reconstructive option when pyogenic thoracolumbar spondylodiscitis is complicated by neurological compromise, mechanical instability, progressive deformity, abscess, or failure of conservative treatment. Appropriate selection of anterior, posterior, or combined fusion should be individualized according to the extent and location of infection, anterior column destruction, spinal alignment, and patient-related factors.

Keywords: Pyogenic spondylodiscitis; thoracolumbar spine; interbody fusion; spinal infection; debridement; instrumentation.

1. Pathophysiology

Three principal pathways are described for the development of spondylodiscitis. Hematogenous spread is the most frequent route and occurs through paired segmental arteries terminating in the vascular vertebral endplate. Infection commonly begins in adjacent vertebral bodies and subsequently extends to the intervening avascular disc. In children, vascular anastomoses extend into the disc, making the disc itself a potential initial site of infection (Placide & Reznicek, 2025).

Potential pathogens may gain access to the bloodstream from open wounds, minor skin trauma, the oral cavity, or the urinary and gastrointestinal tracts. Direct inoculation during surgery, invasive procedures, or trauma represents a second mechanism, while contiguous spread from an adjacent infected structure represents a third route (Berbari et al., 2015). *Staphylococcus aureus*, including methicillin-sensitive and methicillin-resistant strains, remains the most frequently isolated organism. Non-pyogenic infections are more often associated with *Mycobacterium tuberculosis*, atypical mycobacteria, fungi, or *Brucella* species, particularly in susceptible populations (Placide & Reznicek, 2025).

2. Epidemiology and Etiology

Native vertebral osteomyelitis accounts for approximately 3–5% of osteomyelitis, and in patients older than 50 years it is an important manifestation of hematogenous bone infection (Gill et al., 2008). The reported incidence has increased over recent decades in association with population aging, immunocompromising conditions, greater use of intravascular devices, and improved diagnostic testing (La Marca & Brumblay, 2008).

Predisposing factors include diabetes mellitus, steroid therapy, advanced liver disease, intravenous drug use, indwelling vascular catheters, and other conditions associated with impaired immunity or recurrent bacteremia. The lumbar spine is the most frequently involved region, followed by the thoracic and cervical spine. Thoracic infection carries particular concern because of its association with neurological deficit (Dalley et al., 2023).

3. Clinical Diagnosis

The most common presentation is an insidious onset of back pain, reported in the great majority of patients. Constitutional manifestations such as fever, chills, and malaise are less consistent, while neurological deficits occur in a smaller but clinically important proportion of patients (Snell, 2008). Because many cases arise through hematogenous dissemination, history should address recent infections, invasive procedures, travel, intravenous drug use, and relevant comorbidities.

Clinical assessment should include a detailed musculoskeletal and neurological examination. Laboratory evaluation includes blood cultures, erythrocyte sedimentation rate, C-reactive protein, complete blood count, metabolic profile, and liver function tests. Additional microbiological testing may be required according to epidemiological risk. When blood cultures and serological testing fail to establish the causative organism, image-guided aspiration or biopsy may be indicated. Biopsy material should be submitted for microbiological culture and histopathological assessment (Atici et al., 2004; O'Donnell et al., 2023).

4. Imaging Evaluation

Plain radiographs are commonly obtained first. Early radiographs may be normal; later findings include disc-space narrowing, endplate irregularity, bony resorption, vertebral collapse, deformity, and instability. Upright and dynamic views may provide additional information about alignment and mechanical instability.



Figure 1. Upright lateral radiograph demonstrating endplate irregularity and collapse at the infected level (Li & Kam, 2020).

Computed tomography is particularly valuable for defining osseous destruction, subtle pathological fracture, and structural instability. Three-dimensional reconstruction may also contribute to operative planning.



Figure 2. Sagittal CT image demonstrating destructive thoracic vertebral changes (Gill et al., 2008).

Magnetic resonance imaging is the imaging modality of choice because it provides early detection and superior assessment of the disc, vertebral marrow, epidural and paravertebral soft tissues, neural structures, and abscesses. When infection is identified in one spinal region, imaging of additional regions may be considered to exclude noncontiguous lesions (Hosman et al., 2003).



Figure 3. Sagittal T2-weighted MRI demonstrating an epidural abscess with neural compression

5. Differential Diagnosis

Condition	Disc involvement	Endplate changes	Soft tissue	Key clues
Pyogenic spondylodiscitis	Early; reduced disc height	Irregular destruction	Paravertebral/epidural abscess common	Fever; elevated ESR/CRP
Tuberculous spondylodiscitis	Later involvement	Predominantly anterior destruction	Large, smooth abscess	Chronic course; gibbus deformity
Brucellar spondylodiscitis	Usually mild	Minimal destruction	Small or absent collection	Endemic exposure
Modic type I change	Disc generally preserved	Reactive marrow edema	No abscess	No systemic infective features
Metastatic disease	Disc usually preserved	Marrow replacement	Paraspinal mass may occur	Known/suspected malignancy
Compression fracture	Disc preserved	Fracture line/collapse	Usually absent	Trauma or osteoporosis

Table 1. Differential diagnostic features summarized from the Review of Literature in the thesis.

6. Treatment Decision-Making

Management is multidisciplinary and commonly involves medical, infectious-disease, microbiological, and spinal surgical input. Identification of the causative organism is desirable because it permits targeted antimicrobial therapy. Conservative treatment is based on microbiological diagnosis, appropriate antibiotics, spinal immobilization, and close clinical and radiological surveillance for instability, progression of infection, or neurological deterioration (Tsirikos & Jain, 2011).

The duration of antimicrobial treatment remains an area of variation in the literature. The review chapter notes evidence supporting six weeks of targeted treatment in many cases, while longer courses may be selected according to organism, clinical response, inflammatory markers, associated medical conditions, and radiological evolution (Bernard et al., 2015). Immobilization with an appropriate orthosis may be used when vertebral destruction or pain requires mechanical support.

7. Indications for Surgical Management

Operative intervention is considered when neurological compromise, spinal instability, progressive deformity, intractable pain, abscess formation, diagnostic uncertainty, or failure of adequate conservative treatment is present. Neurological compression may arise from epidural abscess, vertebral collapse, or inflammatory granulation tissue. Structural destruction and disc-space collapse can produce segmental instability and progressive kyphotic deformity, particularly at the thoracolumbar junction.

Failure of conservative treatment may be reflected by persistent pain, ongoing systemic infection, persistently elevated inflammatory markers, or radiological progression despite adequate antimicrobial therapy. In these circumstances, surgical debridement removes infected and necrotic tissue, permits decompression when required, and creates the opportunity for mechanical reconstruction of the affected spinal segment.

8. Rationale for Interbody Fusion in Spinal Infection

Pyogenic spondylodiscitis destroys the intervertebral disc and adjacent vertebral endplates and may therefore compromise the integrity of the anterior spinal column. Decompression without adequate reconstruction may aggravate instability or permit progressive deformity. Interbody fusion is used to provide anterior column support, restore spinal stability and sagittal alignment, promote osseous fusion across the affected segment, and facilitate earlier mobilization.

By reducing pathological motion at the infected segment, interbody reconstruction also improves the mechanical environment for healing. The decision to use an interbody device or structural graft should be integrated with the extent of debridement, the degree of bone loss, the need for decompression, and the stability provided by posterior instrumentation.

9. Surgical Approaches to Interbody Fusion

Interbody fusion may be performed through anterior, posterior, lateral/oblique, or combined approaches. The choice depends on the anatomical location of infection, the degree of anterior column destruction, the presence and location of abscesses, the required neural decompression, spinal alignment, and the general condition of the patient.

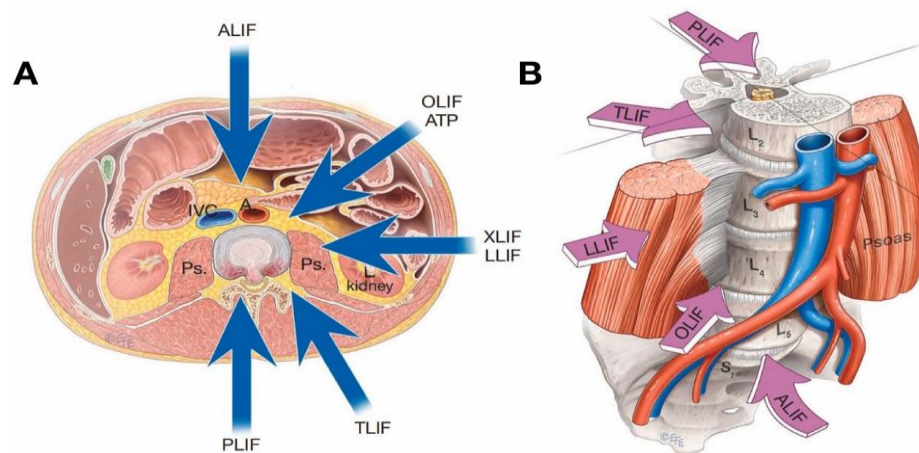


Figure 4. Common lumbar interbody fusion corridors: ALIF, OLIF, XLIF/LLIF, PLIF, and TLIF. Reproduced in the thesis Review of Literature with citation to Jun et al. (2024).

9.1 Anterior Interbody Fusion

The anterior approach provides direct access to the infected disc space and vertebral bodies, permitting extensive debridement and reconstruction of the anterior column. It may be particularly useful when vertebral body destruction or paravertebral abscess formation is substantial. In thoracolumbar disease, anterior reconstruction may require supplemental posterior instrumentation when immediate stability is insufficient.

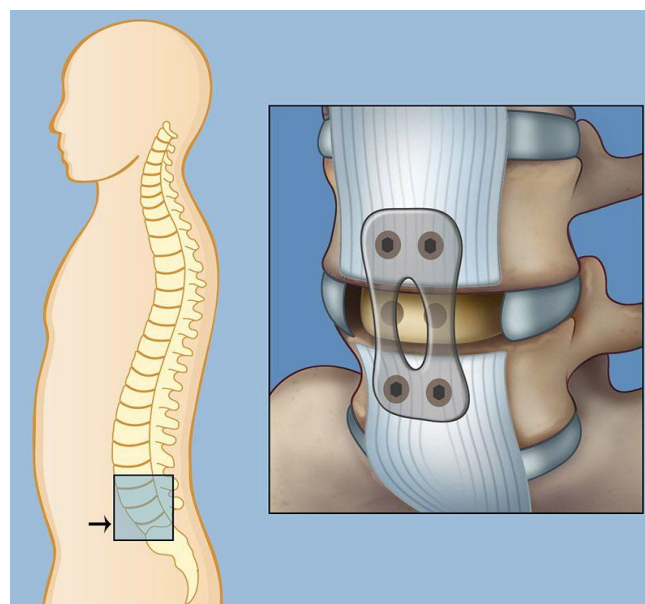


Figure 5. Anterior interbody fusion illustration included in the thesis Review of Literature (Barber et al., 2024).

9.2 Posterior Interbody Fusion

Posterior approaches, including PLIF and TLIF, permit decompression, debridement, interbody reconstruction, and posterior instrumentation through a single operative corridor. This can provide strong posterior stabilization while reconstructing the anterior column indirectly. The review chapter identifies these approaches as suitable options in selected cases of thoracolumbar spondylodiscitis.

9.3 Combined Anterior–Posterior Fusion

Combined anterior and posterior reconstruction may be selected in severe infection characterized by extensive bone loss, major deformity, or marked instability. Anterior debridement and interbody reconstruction address the diseased anterior column, while posterior instrumentation augments biomechanical stability and helps maintain deformity correction. The trade-off is greater surgical morbidity compared with a single approach.

9.4 Lateral and Oblique Interbody Approaches

The Review of Literature also describes lateral lumbar interbody fusion (LLIF) and oblique lumbar interbody fusion (OLIF) as additional corridors to the disc space. These techniques may reduce disruption of posterior musculature, although their appropriateness depends on the level of disease, the location of infection, neural anatomy, and the need for direct decompression or extensive debridement.

10. Practical Synthesis

The material reviewed in the thesis supports a staged clinical logic. Diagnosis requires integration of clinical features, inflammatory markers, microbiology, and imaging rather than reliance on a single test. MRI is central to defining the extent of infection and neural involvement, whereas CT is particularly useful for bony destruction and operative planning. Conservative treatment remains appropriate in selected stable patients without progressive neurological or structural complications. Surgery becomes increasingly relevant when infection threatens neural elements or spinal stability, when deformity progresses, or when adequate medical therapy fails.

Within surgical management, interbody fusion addresses the structural consequence of disc and endplate destruction. Anterior, posterior, and combined strategies should therefore be regarded as complementary options rather than competing procedures. The operative corridor should be selected according to the pathology that must be debrided, the neural structures that require decompression, the amount of anterior column reconstruction required, and the stability needed after surgery.

11. Conclusion

Pyogenic thoracolumbar spondylodiscitis is a potentially destructive infection in which delayed diagnosis or progression may result in abscess formation, neurological compromise, instability, and deformity. Successful management depends on accurate microbiological and radiological assessment, appropriate antimicrobial treatment, and timely recognition of patients who require surgery. Interbody fusion provides a reconstructive means of restoring anterior column support and stability after debridement. The selection of anterior, posterior, lateral/oblique, or combined fusion should be individualized to the extent of infection and structural damage.

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