

# An Overview on Management of Adjacent Segment Disease

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## **Abstract:**

**Background:** Adjacent segment disease (ASD) is a recognized complication following successful spinal fusion surgery, characterized by the development of new clinical symptoms originating from spinal levels adjacent to the fused segment. These symptoms may include back pain, radiculopathy, myelopathy, or spinal instability and are associated with progressive degenerative changes such as disc degeneration, stenosis, facet hypertrophy, deformity, and loss of sagittal alignment. While many patients can be managed conservatively, a subset develops severe pain, neurological deficits, or functional disability that necessitates surgical intervention. Multiple surgical strategies have been described for the management of ASD, including decompression, extension of fusion, and various interbody fusion techniques; however, outcomes remain variable and the optimal management approach continues to be debated. This review aims to outline the pathophysiology, non-operative treatment options, surgical indications, operative techniques, and potential complications associated with the management of adjacent segment disease following spinal fusion.

**Keywords:** Adjacent segment disease; spinal fusion; lumbar spine; revision surgery; decompression; interbody fusion.

## **Introduction:**

Adjacent segment disease (ASD) has been defined as the presentation of a new symptom referable to an adjacent level after patients have undergone successful surgical interventions of a spinal problem and accompanied by related symptoms (radiculopathy, myelopathy or instability). (1)

There are many changes that may occur as a result of degeneration that develops at motion segment proximal or distal to a previous fusion. Findings include stenosis, disc degeneration, facet hypertrophy, scoliosis, lythesis and osteophyte formation, instability, flattening of lumbar lordosis, kyphosis or anterior trunk inclination. These changes are the source of pain and disability, especially in geriatric population. (2)

Many patients can be managed with non-operative treatment. However, for those with severe pain and disability and not responding to medical treatment may warren surgical treatment. (3)

Several operative techniques are available according to the symptoms and radiology such as minimally invasive surgeries, classic decompression or instrumented fusion to achieve the goal of properly restoring the normal shape of the lumbar region. (4)

## **Non-operative treatment of ASD**

The goals of nonoperative treatment are to educate patients, relieve pain, improve function, and prevent chronicity of the problem. Nonoperative treatments include medications, bracing, physical therapy, and epidural steroid injections. Usually one, or any combination of the noted treatments, is applied to the patient with ASD. Nonsteroidal anti-inflammatory drugs NSAIDs are commonly used. Gabapentin may be helpful in treating neuropathic pain associated with radiculopathy. Bracing use is controversial.(5)

### **Surgical management of ASD**

Goals for operative treatment:

- Relief of back pain and leg pain.
- Restoration of spinal stability and alignment.
- Recovery of neurologic deficit.
- Improvement of posture and gait. (6)

The decision to proceed with surgical management of ASD is based on a careful evaluation of the patient's symptoms, the extent of the disease, and the potential risks and benefits of surgery. Common indications for surgical intervention include:

- Persistent or disabling back pain: If nonoperative management fails to provide adequate pain relief, surgical intervention may be considered.
- Intractable leg pain: Radicular pain that is severe, persistent, or interferes with daily activities may warrant surgical treatment.
- Neurological deficits
  - Weakness: Progressive muscle weakness in the legs or buttocks.
  - Numbness or tingling: Sensory loss in the legs or buttocks.
  - Bowel or bladder dysfunction: Changes in bowel or bladder function can be a sign of severe spinal cord compression.
- Progression of the disease
  - Rapid deterioration: If the ASD is progressing rapidly and leading to worsening symptoms, surgical intervention may be necessary to prevent further deterioration.
  - Risk of spinal cord compression: If there is a considerable risk of spinal cord compression, surgical decompression may be required to prevent permanent neurological damage. (7)

### **Surgical intervention**

Every surgery in managing ASD is different from the other. Revision decompression and extension of fusion remains the gold standard surgical treatment for patients with symptomatic ASD; however, the medical literature is inconsistent regarding the clinical effectiveness of such a revision surgery. It was reported only modest improvement in patients that underwent decompression and extension of fusion. In contrast, a previous study reported “good to excellent” results in 70% of patients who underwent revision surgery for symptomatic ASD in their study. To date, studies have not assessed validated pain, disability, quality of life, and utility measures after revision surgery for ASD. Given the broad range of reported outcomes, the long-term effectiveness of revision decompression and extension of fusion in this context remains uncertain. (8)

### **Surgical options for ASD**

Several surgical options are available for the treatment of lumbar ASD. The choice of surgical technique depends on the patient's individual circumstances, including the extent of the disease, the presence of comorbidities, and the patient's preferences. (9)

#### **Revision surgery:**

Removal of failed hardware: In cases where the original fusion hardware has failed, it may be necessary to remove and replace it. (10)

### **Extension of the fusion segment:**

If the adjacent segment disease is extending beyond the original fused segment, the fusion may need to be extended to include additional spinal levels. (9)

### **Decompression:**

- Laminectomy: Removal of the lamina, a bony arch that covers the spinal canal, to relieve pressure on the spinal cord and nerve roots.
- Foraminotomy: Enlargement of the intervertebral foramen, the opening through which the nerve roots exit the spinal canal.
- Discectomy: Removal of a herniated disc. (11)

### **Fusion techniques:**

- Posterior lumbar interbody fusion (PLIF): This technique involves placing a bone graft or interbody cage between the vertebral bodies from the posterior approach. (12)
- Transforaminal lumbar interbody fusion (TLIF): This technique involves accessing the intervertebral space through a lateral approach, allowing for the placement of a bone graft or interbody cage. (13)
- Anterior lumbar interbody fusion (ALIF): This technique involves accessing the intervertebral space from the anterior approach, allowing for the placement of a bone graft or interbody cage. (14)

### **Complications of surgical management of ASD**

#### **The intra-operative complications:**

Wrong level exploration, epidural vein bleeding, injuries to the dura with consequent cerebrospinal fluid (CSF) loss can happen in all kinds of spine surgery or nerve root injury. (15)

#### **Immediate post-operative complications:**

Postoperative dysesthesia, residual pain, neurological deficit, injury to the exiting or the traversing nerve root or epidural hematoma. (8)

#### **Delayed post-operative complications:**

Spondylodiscitis, Pseudocyst formation, Instability, stenosis, change spine curvatures (kyphosis, lordosis, and scoliosis), osteoporosis, facet joint arthritis, ligamentous laxity, hardware failure, hardware-associated pain, recurrent radiculopathy, spinal cord compression, failure of the fused segment to heal properly or sagittal balance disturbances. (16)

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