Surgical Management of Complex Spinal Stenosis

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Lumbar spinal stenosis is among the most common conditions treated by spine practitioners. This session focused on the evaluation and management of patients with complex spinal stenosis, including recurrent or residual stenosis, stenosis and degenerative scoliosis, and thoracolumbar stenosis. The speakers reviewed the clinical and radiographic presentations of patients with complex stenosis and discussed strategies for appropriate nonsurgical and surgical management.

MANAGEMENT OF RECURRENT AND RESIDUAL SPINAL STENOSIS

Joseph D. Smucker, MD, Indiana Spine Group, Carmel, Indiana, USA, discussed the challenges of managing recurrent or residual spinal stenosis at the index level. Positive revision outcomes have been demonstrated for adjacent and noncontiguous nonindex segment degeneration [Shabat S et al. *J Spinal Disord Tech.* 2011]. The SPORT trial [Radcliff K et al. *Spine.* 2013] found overall reoperation rates of 13% within 4 years. Diminished outcomes also were observed for stenosis reoperation at index and adjacent levels combined compared with index surgery.

The clinical features and treatment strategies for recurrent stenosis are shown in Table 1.

Among the possible causes of residual stenosis in which symptoms are not relieved are an incorrect initial diagnosis, failed healing of neurologic structures, and permanent nerve damage. Inadequate decompression, inadequate preoperative or intraoperative imaging, and iatrogenic causes may also result in residual stenosis. Inadequate decompression may be avoided with the use of intraoperative myelography, which has been shown to improve outcome scores [Pao JL, Wang JL. *J Spinal Disord Tech.* 2012]. Using surgical probes and computer-assisted navigation may also be useful. Standing preoperative examinations, such as standing radiographs and standing myelography may assist with assessment of previously unrecognized instability. Upright magnetic resonance imaging (MRI) is becoming more common for preoperative assessment. Treatment options for residual stenosis include revision decompression, revision decompression with instrumentation, and revision decompression with fusion. An advantage of fusion is preservation of the decompression.

Recurrent and residual stenosis may represent a challenging diagnostic and therapeutic scenario. Dr Smucker concluded that an understanding of diagnostic tools and treatment options can lead to reasonable patient outcomes.

SURGICAL TREATMENT OF ADULT DEGENERATIVE SCOLIOSIS AND STENOSIS

Sheeraz A. Qureshi, MD, Mount Sinai Hospital, New York, New York, USA, discussed the management of adult degenerative scoliosis and stenosis. Patients with degenerative scoliosis typically present with neurogenic pain, back pain, and deformity. The goals of surgical treatment are to decompress neural elements and achieve coronal and sagittal balance. There are 6 tiers of surgical treatment options for degenerative scoliosis [Silva FE, Lenke LG. *Neurosurg Focus.* 2010].

Dr Qureshi described 4 types of osteotomies for correcting specific deformities (Table 2).

Surgery for adult degenerative scoliosis is associated with a high rate of complications. In a retrospective multicenter review of 306 patients, wound infection occurred in 4% of the patients [Charosky S et al. *Spine.* 2012]. Dr Qureshi suggested considering use of topical vancomycin powder to lower the risk of infection. Neurologic deficits were reported in about 8% of the patients; these can occur as a result of a dural tear or nerve root compromise. Peripheral nerve deficits occurred in 5% of patients and 20% of patients needed revision surgery due to mechanical complications. Mechanical complications included pseudoarthrosis and adjacent segment disease, such as proximal junctional kyphosis, a sharp angular kyphosis above the upper instrumented vertebra.

Finally, according to Dr Qureshi, there is a role for minimally invasive surgery in adult patients with degenerative scoliosis, using tubular decompression, percutaneous screws, and lateral access surgery.

DECOMPRESSION FOR THORACOLUMBAR STENOSIS

Jung U. Yoo, MD, Oregon Health and Science University, Portland, Oregon, USA, reviewed available evidence on the management of thoracic spinal stenosis. Thoracic stenosis is a degenerative disorder that produces enlargement of the structures surrounding the dural sac, with mainly posterior compression. Thoracic stenosis is classified as primary, secondary, and iatrogenic stenosis.

Most patients with thoracic spinal stenosis present with sensory abnormalities of the lower extremities, often in a stocking or nondermatomal distribution. Lower-extremity weakness occurs in 90% of patients, and 30% to 40% have bowel and bladder dysfunction. In a series of 26 patients in a 1987 study by Yonenobu and

Table 1. Recurrent Spinal Stenosis: Causes and Treatment Techniques

Causes and Features	Treatment Strategies
Recurrent disc herniation [Lebow RL et al. *Spine.* 2011]	Treatment depends on surgeon preference
Almost 25% radiographic	Revision surgery
About 10% symptomatic	Percutaneous and open techniques have similar results over time [Patel MS et al. *Bone Joint J.* 2013; Fu TS et al. *Spine.* 2005]
May be clinically silent disc extrusion	Comparable results with primary intervention [Papadopoulos EC et al. *Spine.* 2006]
	Challenging cases
	Calcified, sequestrated, instability
	Many options for revisions
Index segment degeneration	Revision decompression and instrumental fusion
Facet arthropathy and ligamentum flavum hypertrophy	Viable option with positive functional outcome improvements [Mendenhall SK et al. *J Spinal Disord Tech.* 2014]
Synovial cyst	Laminectomy alone may be effective with facet- sparing techniques [Ganau M et al. *Neurol Med Chir.* 2013]
Recurrence following resection may be rare [Ayberk G et al. *Neurol Med Chir (Tokyo).* 2008]	Preoperative instability is an indication for fusion
Degenerative instability	Revision decompression and fusion a viable strategy
	No advantage with any specific fusion type
	Role for prevention with novel devices?
Iatrogenic instability	Anterior procedures may have important role in treatment [Heller JG et al. *J Spinal Disord.* 2000]
Incidence of recurrent leg or back pain higher with aggressive vs limited discectomy [McGirt MJ et al. *Neurosurgery.* 2009]	Anterior standalone LIF may be appropriate [Konig MA et al. *Eur Spine J.* 2013]
Incidence of recurrent disc herniation higher with limited discectomy [McGirt MJ et al. *Neurosurgery.*2009]	
May be caused by aggressive decompression [Kaner T, Tutkan I. *Turk Neurosurg.* 2009]	

LIF, lumbar interbody fusion.

Table 2. Osteotomies for Correcting Specific Deformities

Type of Osteotomy	Features
Smith-Peterson	Resect superior facet
	Relies on hinging mobile intra-articular disc to correct kyphosis
	Best for local curves
	Performed at ≥2 levels
	10° correction per level
Ponte	Total excision of selected facet joint
	Results in abutment of pedicles
	Effective in long, flexible kyphosis without rotation
Pedicle subtraction	35° wedge resection of posterior elements, pedicles, part of vertebral body
	Allows bony contact between segments to fuse
	Single osteotomy allows 30° to 50° of correction
	Can correct coronal deformity if done asymmetrically
	Short angular deformity superimposed on global curve
	Positive sagittal imbalance > 6 cm
Vertebral column resection	Greatest potential to correct sharp, rigid deformities
	Complex coronal deformities

colleagues, those with lesions above T9 tended to have spastic paresis, while those with lesions in the region of T11-T12 had flaccid paralysis.

The diagnosis of thoracic stenosis is confirmed by postmyelogram computed tomography or MRI. It is important to determine whether the primary compression is caused by anterior or posterior structures. Patients with thoracic stenosis often have lumbar stenosis as well. Two studies have reported the presence of lumbar stenosis in 80% [Epstein NE, Schwall G. *J Spinal Disord.* 1994] and 66% [Palumbo MA et al. *Spine.* 2001] of patients with thoracic stenosis. In lumbar stenosis, accurate determination of the involved spinal levels is critical. Complete 3-D imaging of the lumbar spine should be performed to ensure that a more caudal lesion is not present.

Observation may be appropriate for patients with myelopathy without incapacitating claudication or weakness. Patients who present with weakness and gait abnormality should be treated with surgery. Laminectomy is sufficient treatment for most patients with posterior compression caused by hypertrophy of the posterior structures and fusion generally is not required. Patients with ossification of the posterior longitudinal ligament may need anterior decompression. Surgery requires careful positioning and neuromonitoring. The decompression must be wide enough to include the medial aspects of the facet joints and must include all potentially compressive levels.

Adequate decompression results in resolution of neurologic symptoms in most patients. Epstein and Schwall reported good or excellent results of laminectomy in the majority patients with primary thoracic stenosis in a 1994 study. A 1979 study documented partial recovery in 4 patients treated with laminectomy, although some continued to experience weakness, and stenosis recurred at the decompressed levels in one patient. All 6 patients in a 1987 study improved following laminectomy, with complete recovery in 2 of the patients.