

## **Degenerative Spondylolisthesis**

### Degenerative Spondylolisthesis

Anterior displacement of one vertebral body on another without a fracture (see spondylolisthesis) is termed degenerative spondylolisthesis. This condition may be a source of low back pain, as well as radicular or referred leg pain. Degenerative spondylolisthesis occurs five to six times more frequently in woman and usually occurs after the age of 40 years. The L4-5 interspace is 6 to 10 times more frequently involved than adjacent levels.

The degenerative lesion is believed to be the result of long-standing spine instability. Degeneration of the disc accompanied by degeneration of the facet joints allows vertebral translation. The facet joints may be sagittally or horizontally oriented and therefore parallel to each other, or they may be anomalous in their orientation and asymmetric. In both of these instances, the articular processes are free to glide forward one on the other, causing slippage as the joints degenerate. The slip seldom exceeds 30% of the width of the vertebral body unless there has been prior surgical intervention.

A thorough patient history and physical examination are always the first steps in the diagnosis. Back pain is the most commonly reported symptom, often follows a variable course, and is usually unrelated to trauma. The back pain is mechanical and is usually relieved by rest. Radiation of pain into the posterolateral thighs is common. Leg pain is usually diffuse, involving dermatomes and muscles innervated by the L4, L5 and S1 nerve roots. The leg pain is classically accentuated by walking and relieved by rest. Patients may have “drop episodes” characterized by unexpected falls during ambulation.

The results of a physical examination in patients with degenerative spondylolisthesis may be nonspecific. Hamstring tightness is a common finding and patients may have a type of waddling gait. When stenotic symptoms are severe, a fixed forward-flexed posture may be observed. Except in very thin patients, the deformity is not usually appreciated on examination or palpation. Although a neurologic examination is critical, results are often normal and/or nonspecific. Findings may include bilaterally absent reflexes, spotty sensory loss and possible muscle weakness or atrophy.

### *Surgical Treatment*

#### ***Decompression without Fusion***

The surgical treatment of lumbar spinal stenosis with associated degenerative lumbar spondylolisthesis involves either decompression alone or decompression with lumbar fusion. A meta-analysis of the literature from 1970 to 1993 included 11 articles that met inclusion criteria on decompression without fusion. Overall, only 69% of patients were found to have satisfactory results following surgical decompression without concomitant fusion. Thirty-one percent of the patients in nine studies in which slip progression was recorded showed an increase in the degree of slip. However, in most studies, there was no correlation between clinical outcome and the amount of slip progression.

In a prospective, randomized study comparing decompression alone and combined decompression with non-instrumented fusion for degenerative spondylolisthesis, only 11 of 25 patients (44%) having decompression without fusion had satisfactory results. This group also had significantly more post operative low back and leg pain than the fusion group, and had an average increase of 50% in slip from preoperative levels.

#### ***Decompression with Fusion***

A meta-analysis of the literature on degenerative spondylolisthesis found only six studies that met the inclusion criteria for treatment using decompression with fusion. In these studies, 79% of patients reported satisfactory outcome following decompression without fusion. Only three of the studies were

prospective and randomized; the most widely quoted study compared decompression alone to decompression with spinal fusion in the treatment of L3-4 and L4-5 degenerative spondylolisthesis with spinal stenosis. The authors reported improved results when concomitant intertransverse process fusion was performed in addition to decompression when compared with decompression alone. Ninety-six percent good to excellent results were noted in the group and only 44% good to excellent results in the group. Thirty-six percent of those undergoing had a pseudoarthrosis; however, all had either an excellent or good result. The authors concluded that the results of surgical decompression with in situ fusion were superior to those of decompression alone in the treatment of spinal stenosis associated with L3-4 and L4-5 degenerative spondylolisthesis. The authors also concluded that the decision to perform fusion should be based on the presence or absence of preoperative spondylolisthesis rather than other factors such as patient age or gender, disc height or the amount of bone resected during decompression.

The relationships between bone regrowth following surgical decompression for lumbar spinal stenosis and long-term outcome have also been evaluated. In general, satisfactory outcome has been found to be inversely related to the amount of bone regrowth. Although patients with degenerative spondylolisthesis do show some bone growth following lumbar decompression and fusion, the degree of regrowth is less than in those patients who undergo decompression alone without fusion. These results are also reflected in the outcome following surgery; outcome was shown to be significantly improved in patients undergoing decompression with spinal fusion. Although this study was retrospective, results suggest that fusion stabilizes the spine, resulting in less bone regrowth and subsequent recurrent stenosis.

Decompressive lumbar laminectomy with fusion is generally recommended for patients with spinal stenosis associated with degenerative spondylolisthesis. In elderly, low demand patients with more pain resulting from radiculopathy than from pseudoclaudication, laminotomies without fusion may be performed. This procedure may have less risk of subsequent slip progression if there is significant collapse of the disc spaces and vertebral osteophyte formation.

Multiple studies have shown a higher fusion rate with the addition of rigid spinal instrumentation. To date, no study has determined what radiographic criteria can be identified preoperatively to predict the probability of a successful noninstrumented fusion. If a clinician believes that a noninstrumented fusion will lead to a successful fusion, pedicle screw instrumentation should be used in those patients who are determined to be at risk for pseudoarthrosis following a noninstrumented fusion.

### Summary

The natural history of untreated spinal stenosis either with or without degenerative spondylolisthesis is relatively benign but progressive. The literature to date suggests that the natural history of spinal stenosis, with or without degenerative spondylolisthesis is characterized by improvement in approximately one third of patients and deterioration in approximately 10% of patients. The remaining patients have a generally static clinical course over time, with little if any improvement.

There are few data to support the routine use of fusion in the surgical treatment of patients with lumbar spinal stenosis that is not associated with degenerative spondylolisthesis. Support exists for the use of decompression and fusion in the treatment of lumbar spinal stenosis associated with degenerative spondylolisthesis. Many studies indicate that the fusion rate is improved in patients undergoing instrumented fusion. The future role of bone graft substitutes and/or bone morphogenic proteins in spinal fusion continues to be studied. These biologic agents will likely have an increased role in the future of the surgical treatment of patients with these complicated spinal ailments.

### Annotated Bibliography

#### *General*

Sengupta D, Herkowitz H: Lumbar spinal stenosis treatment strategies and indications for surgery. *Orthop Clin North Am* 2003;34:281-295.

This review article describes the natural history and treatment options, both nonsurgical and surgical, for patients with lumbar spinal stenosis. Important discussions on degenerative spondylolisthesis, iatrogenic instability, recurrent or junctional stenosis and treatment algorithms are also included.

#### *Lumbar Spinal Stenosis*

Arinzon A, Adunsky A, Fidelman Z, Gepstein R: Outcomes of decompression surgery for lumbar spinal stenosis in elderly diabetic patients. *Eur Spine J* 2004;13:32-37.

This retrospective study on decompressive surgery for spinal stenosis compared elderly diabetic patients with gender and age-matched controls. The authors found poorer results for diabetic patients with regard to basic activities and pain improvement after surgery. The outcome for patients with diabetes depends on the presence of other comorbidities, concurrent diabetic neuropathy, duration of diabetes and insulin treatment.

Epstein NE: Lumbar laminectomy for the resection of synovial cysts and coexisting lumbar spinal stenosis or degenerative spondylolisthesis: An outcome study. *Spine* 2004;29:1049-1055.

This article reviews the outcomes of surgical treatment for patients with synovial cysts and stenosis, with or without concomitant spondylolisthesis. The author noted the high percentage of patients who had postoperative development or progression of spondylolisthesis after laminectomy. Because synovial cysts reflect disruption of the facet joint and some degree of instability, the author recommended consideration of primary fusion to improve surgical results for patients in both categories.

Gunzburg R, Keller TS, Szpalski M, Vandeputte K, Spratt KF: A prospective study on CT scan outcomes after conservative decompression surgery for lumbar spinal stenosis. *J Spinal Disord Tech* 2003;16:261-267.

The postoperative CT scans of patients who underwent conservative lumbar laminarthrectomy were analyzed in this prospective study. This procedure involved decompressing the central and nerve root canals while respecting the integrity of the neural arches, facet joints and most muscle attachments. The authors noted a statistically significant increase in inter-facet bony canal diameter of the operated levels.

Gunzburg R, Keller TS, Szpalski M, Vandeputte K, Spratt KF: Clinical and psychofunctional measures of conservative decompression surgery for lumbar spinal stenosis: A prospective cohort study. *Eur Spine J* 2003;12:197-204.

The authors prospectively evaluated psychometric and functional outcomes for patients who had conservative lumbar laminectomy. With short-term follow-up, the authors reported outcomes to be as successful as standard more aggressive decompressive procedures presented in the literature. The authors noted that even in a highly organic disorder such as spinal stenosis, illness behavior plays an important role in predicting surgical outcomes.

Ragab AA, Fye MA, Bohlmann HH: Surgery of the lumbar spine for spinal stenosis in 118 patients in 70 years of age or older. *Spine* 2003;28:348-353.

A consecutive case retrospective review evaluating the outcome of lumbar spine surgery for spinal stenosis in elderly patients is presented. The authors report on a 2-year follow-up of 118 patients from 70 to 101 years of age who were surgically treated for lumbar spinal stenosis. Advanced age did not increase the morbidity associated with this surgery when compared with other studies of a younger population, nor did advanced age decrease patient satisfaction or return to activities.

#### *Degenerative Spondylolisthesis*

Kornblum MB, Fischgrund JS, Herkowitz HN, Abraham DA, Berkower DL, Ditkoff JS: Degenerative lumbar spondylolisthesis with spinal stenosis: A prospective long-term study comparing fusion and pseudoarthrosis. *Spine* 2004;29:726-733.

This article presents the result of a prospective, randomized study on patients who underwent posterior lumbar decompression with bilateral posterior fusion for degenerative spondylolisthesis and spinal stenosis to determine the long-term influence of pseudoarthrosis. The authors showed that a solid fusion improves long-term clinical results for back and lower limb symptomatology compared with prior shorter-term studies, which indicated no significant difference in clinical outcome between solid fusion and pseudoarthrosis.