Spondylolysis and spondylolisthesis

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Definitions

Spondylolysis refers to a defect in the pars interarticularis of a vertebra. This defect has been defined as dysplastic with elongation and thinning of the pars interarticularis or isthmic with a manifest defect through this structure.

Spondylolisthesis refers to the displacement of a vertebral body in relation to the vertebra below. A lysis causes a forward slipping. A vertebral slipping can also be caused by disc degeneration and spondylarthrosis.

Occurrence

Lysis occurs in about 6% of Nordic and western European adult population (Friberg 1939, Laurent 1958, Fredrickson 1984). Lysis is not found in infants (Batts 1939, Rowe and Roche 1953). The incidence increases from 5 to 12 (–15) years of age. In more than 90% of the cases, the location is L5, and in more than 5% L4. Heredity (Friberg 1939, Stewart 1953, Haukipuro et al 1978, Wynne-Davies and Scott 1979), some sports and gymnastics (Wiltse et al 1975, Jackson et al 1976, Ichikawa et al 1982, Swärd et al 1989) can increase the risk for lysis. About 80% of lysis patients demonstrate an olisthesis, mostly a minor one. Of patients with radiographically verified lysis and low back pain, one fifth had an olisthesis with Meyerding degree II or more, viz. more than 25% slipping (Saraste 1984, Frennered 1991).

Progress of slipping

A progress of olisthesis can occur, though it is not very common. According to the follow-up study of Seitsalo (1990), a low-degree olisthesis increased 1% and a high-degree olisthesis 7%. Most of the progress occurred at the prepubertal growth spurt. Frennered (1991) found a 3% progress with a peak at the age of 25 years. Saraste (1984) found that one third of adults and one fifth of younger patients showed a progress of more than 5 mm during a 20-year follow-up. Disc degeneration was an important factor to contribute to the progress of slipping.

Risk factors

There is a correlation between a high degree of olisthesis and local vertebral hypoplasia (Fredrickson 1984, Saraste 1984, Lindholm et al 1990), lumbosacral kyphosis (Pizutillo et al 1986, Bradford et al 1987 and 1990, Seitsalo 1990, Lindholm et al 1990), and disc degeneration, particularly in L4 cases (Saraste 1984). The priority and pathomechanism of the findings is still unclear. These signs might contribute to the decision to make surgery when in doubt.

Symptoms

The above mentioned studies of Saraste (1984), Seitsalo (1990), and Frennered (1991) show that symptoms are correlated to the degree of olisthesis. A lysis without or with only a few millimeters olisthesis and with a normal disc height does not increase the risk for low back pain and is no indication for surgery, whereas a majority, viz. two thirds, of patients with high-degree olisthesis risk chronic low back pain with or without sciatica. A combination of L4 lysis and a high-degree olisthesis gives major back problems in nearly all cases. L4 lysis shows an over-representation among persons with disability pension caused by low back pain. Thus, a high-degree olisthesis in itself can make an indication for surgery to prevent future back problems.

Lysis is often diagnosed during adolescence when unspecific back pain of varying degree is common. In addition, to verbalize back pain is not easy for children. Pain equivalents, such as lumbo-ischial contracture, pain scoliosis, and walking anomaly, might be more informative than an answer to the question if pain exists. These findings make an indication for surgery. Neurological deficiencies occur in some percent of lysis patients. Improvement can be expected after surgery.

In lysis patients past middle age, no special consideration is needed as for the lysis. Indications for surgery are similar as those made by other pathogenetic factors causing spinal stenosis or instability.

According to epidemiologic studies and Finnish and Swedish long-time follow-ups, the need of olisthesis

surgery for adolescents in Sweden averages 50 cases yearly, and twice as much for adults. This is in accordance with Nachemsons (1991) estimation.

Surgery

If there is an indication for surgery, there is a choice between posterior and anterior or a combined approach with or without instrumentation and decompression.

Decompression alone is indicated only for senior patients with spinal stenosis and lack of instability. A complementary decompression in addition to a fusion increases the risk for postoperative olisthesis progress (Laurent and Osterman 1976, Kim et al 1989, Seitsalo 1990, Frennered 1991). The need of decompression should be judged individually.

Before making comparisons between different fusion methods, one should remember that the fusion rate averaged 40% in the 1950's, 60% in the 1960's and nearly 90% in the 1980's. There are symptom free patients after unsuccessful fusion surgery. On the other hand, there is documentation that the clinical success rate is clearly correlated to the fusion rate (Kim et al 1990, Frennered 1991).

The results of a mere *lysis fixation* are unsure, and the indication for this type of surgery is supposed to be rare.

The fusion rate for an *anterior fusion* alone does not exceed 75% in any material. An anterior instrumentation rather decreases than increases this percentage.

Posterolateral fusion in situ without spinal instrumentation in adolescents and young adults gives a solid fusion in nearly 100%. The complication rate for an experienced scoliosis surgeon is down around 0% for this method. In a material of adult patients with severe olisthesis, a posterolateral fusion in situ without instrumentation gave solid fusion in 85–90% (Pizzutillo et al 1986, Harris and Weinstein 1987, Peek et al 1989, Seitsalo 1990, Frennered 1991). In 200 patients with severe olisthesis and fusion in situ without instrumentation, Schoenecker et al (1990) reported, however, a postoperative cauda equina syndrome in 6%. It was not considered as iatrogenic. A reoperation with decompression and stabilization gave a regression of the symptoms in most cases. An outstandingly high pseudarthrosis rate in posterolateral fusion was reported by Herron and Newman (1989), viz. 76%. They used bank bone.

In spite of a radiographically solid fusion, a progress of slipping can occur (Suezawa & Walker 1978, Suezawa et al 1981, Boxall et al 1979, Seitsalo 1990). The time of fusion consolidation is long, up to 12 months (Johnsson et al 1990). No additional late complications nor symptoms which could be referred to a posterolateral fusion in situ nor increased occurrence of spondylarthrosis on adjacent levels have been reported.

The indications for spinal surgery and instrumentation are getting wider and wider. An additional instrumentation in posterolateral fusion has increased the fusion rate for old patients but not for patients younger than 30–40 years of age. The complication rate has increased along with the spinal instrumentation in all age categories and might average more than 10% today. However, much higher complication rates have been reported; 29% in primary spinal surgery and 63% in reoperations (Whitecloud et al 1989), whereas series made by a very limited number of experienced surgeons show very low complication rates.

A combination of anterior and posterior approach increases the fusion rate in cases with severe spondylolisthesis. Smith and Bohlman (1990) reported a method for a combined posterior and anterior fusion, decompression and bone grafting through a posterior approach without instrumentation. Their results on 11 adult patients with severe olisthesis and preoperative neurological symptoms were excellent.

A solid fusion reduces olisthesis-related pain contracture, scoliosis, and walking anomalies. It can contribute to a reduction of lumbosacral kyphosis and slipping (Boxall et al 1979, Bradford 1979, Pizzutillo 1986, Seitsalo 1990, Frennered 1991). In spite of this, trials to reduce olisthesis are increasing in number. Documented complication rates—mainly neurological—vary from 15% to more than 60% in different materials with different reduction methods. Later reduction loss is common. Bradford (1979) reported 15% neurological complications and 20% pseudarthroses at olisthesis reduction.

Summary

Lysis is common and its causes are mainly constitutional. Most of slipping has already occurred when the patient comes for consultation. A further progress is often caused by disc pathology. Neurological deficits are rare. A high-degree olisthesis and L4 location are risk factors for future back pain. Asymptomatic lysis with or without olisthesis should not be treated. A posterolateral fusion in situ without instrumentation gives good results in adolescents and young adults, whereas old patients benefit from instrumentation. Reduction cannot be recommended as a routine method.

References

Bradford D S, Boachie-Adjei O. Treatment of severe spondylolisthesis by anterior and posterior reduction and stabilization. A long-term follow-up study. J Bone Joint Surg (Am) 1990; 72A: 1060–6.

Bradford D S. Treatment of severe spondylolisthesis. A combined approach for reduction and stabilization. Spine 1979; 4: 423–9 .

Bradford D S, Gotfried Y. Staged salvage reconstruction of grade IV and V spondylolisthesis. J Bone Joint Surg (Am) 1987; 69-A: 191–202.

Fredrickson B E, Baker D, McHolick W J, Hansen A Y, Lubicky JP. The natural history of spondylolysis and spondylolisthesis. J Bone Joint Surg (Am) 1984; 66A: 699–707.

Frennered K. Symptomatic lumbar spondylolisthesis in young patients. A clinical and radiological follow-up after non-operative and operative treatment. Thesis 1991.

Friberg S. Studies on spondylolisthesis. Acta Chir Scand 1939; Suppl 55.

Harris I E, Weinstein S L. Long-term follow-up of patients with grade III and IV spondylolisthesis. Treatment with and without posterior fusion. J Bone Joint Surg (Am) 1987; 69A: 960–9.

Haukipuro K, Keranen N, Koivisto E, Lindholm R, Norio R, Punto L. Familial occurrence of lumbar spondylolysis and olisthesis. Clin Genet 1978; 13: 471–6.

Herron L D, Newman M H. The failure of ethylene oxide gassterilized freeze-dried bone graft for thoracic and lumbar spinal fusion. Spine 1989; 14: 496–500.

Ichikawa N, Ohara Y, Morishita T, Taniguichi Y, Koshikawa A, Matsukura N. An etiological study on spondylolysis from a biomechanical aspect. Br J Sports Med 1982; 16: 135–141.

Jackson D W, Wiltse L L, Cirincione R J. Spondylolysis in the female gymnast. Clin Orthop 1976; 117: 68–73.

Johnsson R, Selvik G, Strömqvist B, Sundén G. Mobility of the lower lumbar spine after posterolateral fusion determined by roentgen stereophotogrammetric analysis. Spine 1990; 15: 347–50.

Kim S S, Denis F, Lonstein J E, Winter R B. Factors affecting fusion rate in adult spondylolisthesis. Spine 1990; 15: 979–84.

Laurent L E, Osterman K. Operative treatment in spondylolisthesis in young patients. Clin Orthop 1976; 117: 85–91.

Laurent L E. Spondylolisthesis. Acta Orthop Scand 1958; Suppl 35.

Lindholm T S, Ragni P, Ylikoski M, Poussa M. Lumbar isthmic spondylolisthesis in children and adolescents. Radiologic evaluation and results of operative treatment Spine 1990; 15: 1350–5.

Nachemson A. Orthopaedics in year 2000. Acta Orthop Scand 1991; Suppl 241.

Peek R D, Wiltse L L, Reynolds J B, Thomas J C, Guyer D W, Widell E H. In situ arthrodesis without decompression for grade III or IV isthmic spondylolisthesis in adults who have severe sciatica. J Bone Joint Surg (Am) 1989; 71A: 62–8.

Pizzutillo P D, Mirenda W, MacEwen G D. Posterolateral fusion for spondylolisthesis in adolescence. J Pediatr Orthop 1986; 6: 311–6.

Rowe G G, Roche M B. The etiology of separate neural arch. J Bone Joint Surg (Am) 1953; 35A: 102–10.

Saraste H. Spondylolysis and spondylolisthesis. Clinical and radiographic relationships and prognostic signs. Thesis 1984.

Schoenecker P L, Cole H O, Herring J A, Capelli A M, Bradford D S. Cauda equina syndrome after in situ arthrodesis for severe spondylolisthesis at the lumbosacral junction. J Bone Joint Surg (Am) 1990; 72A: 369–77.

Seitsalo S. Spondylolisthesis in children and adolescents. A long-term clinical and radiological study. Thesis 1990.

Smith M D, Bohlman H H. Spondylolisthesis treated by a single-stage operation combining decompression with in situ posterolateral and anterior fusion. An analysis of eleven patients who had long-term follow-up. J Bone Joint Surg (Am) 1990; 72A: 415–21.

Stanton R P, Meehan P, Lovell W W. Surgical fusion in childhood spondylolisthesis. J Pediatr Orthop 1985; 5: 411-5 .

Stewart T D. Age incidence of neural arch defects in Alaskan natives considered from the standpoint of etiology. J Bone Joint Surg (Am) 1953; 35-A: 937–50.

Suezawa Y, Bernoski F P, Jacob H A C. A comparison of the long-term results of three types of posterior fusion of the lumbar spine for spondylolisthesis. Intern Orthop 1981; 5: 291–7.

Suezawa Y, Walker N. Progredientes Wirbelgleiten bei schwerer Spondylolisthesis. Z Orthop 1978; 116: 325–30.

Swärd L, Hellström M, Jacobsson B, Peterson L. Spondylolysis and the sacro-horizontal angle in athletes. Acta Radiologica 1989; 30:359–64.

Whitecloud T S, Butler J C, Cohen J L, Candelora P D. Complications with the variable spinal plating system. Spine 1989; 14: 472–6 .

Wiltse L L, Widell E H, Jackson D W. Fatigue fracture; the basic lesion in isthmic spondylolisthesis. J Bone Joint Surg (Am) 1975; 57A: 17–22.

Wynne-Davies R, Scott J H S. Inheritance and spondylolisthesis. A radiographic family survey. J Bone Joint Surg (Br) 1979; 61B: 301–5.