Faisal F. Adam

Surgical management of isthmic spondylolisthesis with radicular pain

Accepted: 15 May 2003 / Published online: 3 July 2003
© Springer-Verlag 2003

Abstract Forty-six patients with low-grade isthmic spondylolisthesis (27 grade I and 19 grade II) and radicular pain underwent surgery after failure of conservative treatment for 6 months. Fusion and decompression was carried out in 23 patients (group 1) and fusion without decompression in the other 23 patients (group 2). Instrumentation was used in 16 patients who had instability and hypermobility as seen by dynamic radiography. Results were assessed functionally and radiographically and graded according to Stauffer and Coventry. The follow-up was an average of 20 (12–36) months. In group 1 there were 17 patients with excellent to good results, and in group 2, 21 patients. There was no significant statistical difference between the fusion rate in the two groups. Decompression in addition to fusion in adults with low-grade isthmic spondylolisthesis and radicular pain does not appear to improve the functional outcome.

Résumé Quarante-six malades avec spondylolisthésis isthmique (27 grades I et 19 grades II) et douleurs radiculaires ont été opérés après échec d'un traitement conservateur pendant 6 mois. Fusion et décompression ont été faites chez 23 malades (groupe I) et fusion sans décompression chez les 23 autres malades (groupe II). L'Instrumentation a été utilisée chez 16 malades qui avaient une instabilité et une hypermobilité décelées par des radiographies dynamiques. Les résultats ont été étudiés au plan fonctionnel et radiographique et classés d'après Stauffer et Coventry. Le suivi était en moyenne de 20 (12–36) mois. Il y avait 17 malades avec un excellent ou bon résultat dans le groupe I, et 21 malades dans le groupe II. Il n'y avait aucune différence statistique significative entre le taux de la fusion dans les deux groupes. La décompression ajoutée à la fusion chez l'adulte avec spondylolisthésis isthmique et radiculalgies ne paraît pas améliorer le résultat fonctionnel.

Introduction

A variety of recommendations have been made for treatment of adults who have low-grade isthmic spondylolisthesis with radicular pain. The type of operation that should be performed when patients have not responded to non-operative treatment remains controversial. Some authors have recommended decompression and arthrodesis, and others have recommended arthrodesis alone [2, 5, 7, 14]. The literature on this subject is confusing, so the aim of this study was to compare the functional outcome of fusion alone with that of decompression in addition to fusion.

Material and Methods

Between 1994 and 2000, 46 patients presented with low-grade isthmic spondylolisthesis (27 grade I and 19 grade II) and radicular pain, and underwent surgery at the Department of Orthopaedic Surgery, Assiut University Hospital. The criteria for inclusion were grade I or II isthmic spondylolisthesis, an age of more than 20 years, persistent pain in the back and the lower extremities despite non-operative treatment for at least 6 months, no previous operation on the spine or coexisting spinal deformity and no cauda equina compression. For patients with sciatica, this meant pain that radiated at least below the knee, but for patients with L4 radiculopathy, the entire anterior portion of the thigh had to be involved. Fusion and decompression of the nerve root was done in 23 patients (group 1) but fusion only in the other 23 (group 2). Before surgery there was no significant difference between the two groups as regard to the severity of lumbar pain and radicular pain ($P>0.05$). There were 21 women and 25 men; age ranged from 20 to 53 years. Radicular pain was as severe as lumbar back pain in 37 (80.4%) patients. Dermatomal fields of radicular pain were L4 in five patients, L5 in 23 and S1 in eight; the remaining ten patients had undetermined sciatica radiating to the calf or ankle. Thirteen patients had bilateral radicular pain. Isthmic spondylolisthesis was located 22 times at L4–L5, 20 times at L5–S1, once at L3–L4 and three times at double levels—two at (L4–L5 and L5–S1) and one at (L3–L4 and L4–L5) (Table 1). Assessment was based on functional evaluation, including professional activity, daily life and intensity of lumbar and radicular pain. Plain radiographs of the lumbosacral spine (including antero-posterior, lateral, oblique and flexion-extension stress views) were done pre-operatively in all patients and repeated at the recent and the final fol-

F. F. Adam (✉)
Department of Orthopaedic Surgery,
Assiut University Hospital, Assiut, Egypt
e-mail: adam_ff@yahoo.com
Tel.: +2-088-312321, Fax: +2-088-333327

Table 1 Pre-operative and post-operative data of the patients studied ($n=46$)

Patient characteristics	Group 1 Fusion and decompression ($n=23$)	Group 2 Fusion, no decompression ($n=23$)
Age in years [mean (range)]	33.8 (22–53)	32.6 (20–48)
Gender (women/men)	9/14	12/11
Pre-operative findings		
Clinical		
Low back pain	23	23
Radicular pain	23	23
Radiological		
Level		
L3–4	–	1
L4–5	12	10
L5–S1	10	10
L3–4 and L4–5	–	1
L4–5 and L5–S1	1	1
Grade		
1	17	10
2	6	13
Operation		
Postero-lateral fusion	5	16
Modified sacrospinalis muscle–pedicle bone graft	9	–
Instrumentation and postero-lateral fusion	9	7
Postoperative		
Fusion		
Union	19	21
Pseudarthrosis	4	2
Back pain		
None	8	12
Episodic/moderate	9	9
Fit	2	1
Constant	4	1
Radicular pain		
None	17	21
Constant	6	2
Functional outcome:		
Excellent or good	17	21
Fair	2	1
Poor	4	1

low-up. Pre-operative assessment of nerve-root compression was carried out by CT myelography or MRI. In situ postero-lateral fusion was carried out in 21 patients (five in group 1 and 16 in group 2). Modified sacrospinalis muscle–pedicle bone graft [1] was done in nine patients of group 1. Instrumentation using transpedicular screws and rods in addition to postero-lateral fusion was done in 16 patients (nine in group 1 and seven in group 2) (Table 1). The decision to fix usually was based on the dynamic radiographs showing an increase of slipping percentage or the angle of sagittal rotation. Decompression of the nerve root and thecal sac included removal of loose lamina, fibrocartilage, pseudarthrosis and connective tissue around the nerve root to the point where it left the neural foramen. At the beginning of the study period, patients were mainly treated by decompression and fusion, whereas patients with more recent procedures only had a fusion. In the group managed with instrumentation, no attempt was made to reduce the slip or angle of spondylolisthesis other than by employing the

prone position used routinely for the operative approach. Post-operatively all patients were managed with a brace for 2 months. The follow-up period ranged from 12 to 36 (average 20) months. Follow-up evaluations were performed at 2, 6, 12, and 24 weeks and then at 1 and 2 years.

Results

At the final follow-up, clinical, radiological and functional outcomes were assessed. Solid fusion was considered to have occurred if trabeculi were seen between the transverse processes. Pseudarthrosis was present if there was no continuity in the fusion mass or if lateral flexion-extension radiographs demonstrated more than 2° of an-

Fig. 1a–c A 43-year-old woman with isthmic spondylolisthesis at L3–4 and L4–5 and bilateral radicular pain. **a** Pre-operative radiograph. **b, c** Antero-posterior and lateral radiographs 2 years after surgery. Solid fusion without radiolucent lines around the screws

gular motion or more than 2 mm of sagittal motion at the location of spondylolisthesis [4]. Thin fusion was present when there was a spindly graft without mobility on the dynamic radiographs [5]. In patients who had been managed with instrumentation, fusion was assessed in a similar manner (Fig. 1). In addition, if there was a radiolucent line around a pedicle screw, or if a screw had fractured, the dynamic radiographs were repeated.

There was no significant difference between the two groups as regards to fusion rate (Table 1). In group 2, 21 patients had solid fusion and two had pseudarthrosis. In group 1, 17 patients had solid fusion, two had thin fusion and four had pseudarthrosis. All patients with pseudarthrosis had unsatisfactory results.

Function was considered as a composite of pain expression, return to pre-operative work, performance of daily activities and the use of analgesics, and rated according to Stauffer and Coventry [13]. The overall analysis showed excellent or good results in 91.3% of patients in group 2 and 73.9% of patients in group 1 with no statistical significant difference ($P>0.05$). Also, there was no significant difference as regards to radicular pain (Table 1). Functional results showed that eight patients in group 1 and 12 in group 2 had excellent results. In group 1 there were four poor results and in group 2 one (Table 1).

Complications

Six patients had complications. One had a non-fatal pulmonary embolism, one had wound infection that required surgical debridement, one had a haematoma that

required surgical evacuation, and one had a dural tear. In the group treated by modified sacrospinalis muscle–pedicle bone graft, one patient had a painful donor site due to penetration of the sacroiliac joint. In one patient a screw had to be replaced due to irritation of the fifth lumbar nerve root after instrumentation.

Discussion

The treatment of choice for adults with isthmic spondylolisthesis and radicular pain remains a matter of controversy [9, 12]. Various surgical procedures have been undertaken to relieve the symptoms caused by nerve-root pathophysiology in the spinal canal that can be located at several levels. A disc herniation can compress the nerve root, the dural sac and its contents can be compressed against the postero-superior margin of the sacrum, and the nerve root also can be involved in the region of the pars-interarticularis [6]. In the nerve root foramen, dysfunction can be caused by narrowing of the foramen in extension or by stretching produced by the isthmic hook in flexion [10, 11].

Peek et al. [10] reported good results after arthrodesis in adults who had a high-grade slip and severe sciatica. Garreau de Loubresse et al. [5] reported the results for 48 patients who had an arthrodesis for treatment of isthmic spondylolisthesis. Of the 25 patients with arthrodesis alone, four had pseudarthrosis compared with seven of 23 treated with arthrodesis and decompression. Relief of radicular symptoms was also better in the group treated without decompression. In this study the pseudarthrosis rate was 8.7% in the group without decompression and 17.4% in the group with decompression, and there was no significant difference in radicular pain relief between the two groups.

In patients with isthmic spondylolisthesis and radicular pain, we need to differentiate between those with irri-

tation of the nerve root without demonstrable neurological loss caused by posterior arch mobility and those with nerve-root compression and serious neurological injury. Some reports [3, 15] have proposed an anterior approach for lumbar fusion. Kaneda [8] has suggested a posterior approach with instrumentation without laminectomy. For this author, the foramen distraction obtained by these techniques explains the beneficial effects on the radicular pain. However, it also is possible that fusion alone gives suppression of the posterior arch mobility, which is the principal cause of nerve-root irritation. This may explain why postero-lateral fusion alone, preserving and including all posterior elements, restores stability and eliminates nerve-root irritation. This can explain the significant clinical difference between patients with fusion and those with pseudarthrosis, and may also explain why the presence or absence of radicular compression as judged by CT myelography or MRI did not influence the final results. Instrumentation was used in 16 patients in this study, and the decision was based on instability and hypermobility as detected by dynamic radiographs.

In the series of Garreau de Loubresse et al. [5], there was no significant difference in the functional outcomes between groups with and without decompression, as there were 65% excellent or good results in the first group and 88% in the last. The results are comparable to our results. Some authors [13, 16, 17] report that decompression may generate progression of slip and pseudarthrosis, while others report that decompression seldom is required in young patients [8, 13, 15].

In adults with low-grade isthmic spondylolisthesis and radicular pain without demonstrable neurological deficits treated by fusion, an additional decompression does not improve the functional outcome. We believe that relief of radicular pain early in the post-operative period may be a result of the decompression. Later on, relief is achieved by solid fusion, suppressing posterior arch mobility, which, in our opinion, is the principal cause of nerve-root irritation. The use of instrumentation is to abolish hypermobility and instability thereby preventing nerve-root irritation.

References

1. Adam FF (2001) Modified sacrospinalis muscle pedicle bone graft for fusion of isthmic spondylolisthesis. *Int Orthop* 25:326–330
2. Chang P, Seow KH, Tan SK (1993) Comparison of the results of spinal fusion for spondylolisthesis in patients who are instrumented with patients who are not. *Singapore Med J* 34:511–514
3. Cheng CL, Fang D, Lee PC (1989) Anterior spinal fusion for spondylolysis and isthmic spondylolisthesis. *J Bone Joint Surg [Br]* 71:264–267
4. Fischgrund JS, Mackay M, Merkowitz HN, Brower R, Montgomery DM, Kurz LT (1997) Degenerative lumbar spondylolisthesis with spinal stenosis: a prospective, randomized study comparing decompressive laminectomy and arthrodesis with and without spinal instrumentation. *Spine* 22:2807–2812
5. Garrea de Loubresse C, Bon T, Deburge A, Lassale B and Benoit M (1996) Posterolateral fusion for radicular pain in isthmic spondylolisthesis. *Clin Orthop* 323:194–201
6. Gill GG, Manning JG, White HL (1955) Surgical treatment of spondylolisthesis without spine fusion. Excision of the loose lamina with decompression of the nerve roots. *J Bone Joint Surg [Am]* 37:493–520
7. Johnson LP, Nasca RJ and Duuham WK (1988) Surgical management of isthmic spondylolisthesis. *Spine* 13:93–97
8. Kaneda K (1985) Distraction rod instrumentation with postero-lateral fusion in isthmic spondylolisthesis. *Spine* 10:383–389
9. Kim S, Denis F, Lonstein JE, Winter RB (1990) Factors affecting fusion rate in adult spondylolisthesis. *Spine* 9:979–984
10. Peek RD, Wiltse LL, Reynolds JB (1989) In situ arthrodesis without decompression for grade 3 or 4 isthmic spondylolisthesis in adults who have severe sciatica. *J Bone Joint Surg [Am]* 71:62–68
11. Sasso RC, Kozack JA, Dickson JH (1993) The sickle ligament revisited: Release of the lumbosacral ligament via an anterior approach. *Spine* 18:2127–2130
12. Seitsalo S, Osterman K, Hyvarinen H, Schlenzka D, Poussa M (1990) Severe spondylolisthesis in children and adolescents. A long term review of fusion in situ. *J Bone Joint Surg [Br]* 72:259–265
13. Stauffer RN, Coventry MB (1972) Posterolateral lumbar spine fusion. *J Bone Joint Surg [Am]* 54:1195–1204
14. Stillerman C, Schneider J and Gruen J (1993) Evaluation and management of spondylolysis and spondylolisthesis. *Clin Neurosurg* 40:384–415
15. Thomasen E (1985) Intercorporeal lumbar spondylodesis. *Acta Orthop Scand* 56:287–293
16. Turner RH, Bianco AJ (1971) Spondylolysis and spondylolisthesis in children and teen-agers. *J Bone Joint Surg [Am]* 53:1298–1306
17. Wiltse LL, Guyer RD, Spencer CW (1984) Alar transverse process impingement of the L5 spinal nerve. The far-out syndrome. *Spine* 1:31–41