COMPARISON OF IN SITU FUSION AND INSTRUMENTATION WITH FUSION IN TREATMENT OF SPONDYLOLISTHESIS

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We are presenting a retrospective study comparing the results of insitu posterolateral fusion and instrumentation with posterolateral fusion (with or without reduction) performed in 18 (13 female and 5 male) patients with spondylolisthesis. The mean age was 46 (range 20-63), average follow-up was 3.5 (range 1.5-8) years. There was grade 1 spondylolisthesis in 2 patients, grade 2 in 9, grade 3 in 5, grade 4 in one and grade 5 spondylolisthesis (spondyloptosis) with para-aortic neurofibroma in one patient. We performed in situ posterolateral fusion in 10 patients and posterolateral fusion with instrumentation in the remaining 8. Decompression was added in 3 of the cases with instrumentation and reduction in 4 of them. Reduction and decompression were combined in the remaining one patient. In addition to reduction, instrumentation and posterolateral fusion, anterior fusion was also performed in the patient with spondyloptosis. While there were no nonunions in the instrumented group, 2 cases with insitu posterolateral fusion failed to unite. Infection which responded to intravenous antibiotics and debridement occurred in two instrumented cases. Radicular type pain was diminished in all the patients which we achieved union. When reduction was added, in addition to obtaining good decompression, fusion and radicular pain relief, improvement in low back pain due to mechanical imbalance was observed. The two cases who develope pseudoarthrosis were revised with reduction, decompression, instrumentation and posterolateral fusion; union was obtained in both cases. In conclusion, insitu posterolateral fusion appears to have a higher rate of pseudoatrhrosis, but in those cases in which union is achieved, there is not any significant difference in radicular pain relief from those which are instrumented. Addition of reduction distinctly improves mechanical pain as well as the radicular pain. In the instrumented cases however, the infection rate is higher.

Key Words: *Spondylolisthesis, in situ fusion, instrumentation*

INTRODUCTION

Many different surgical methods has been suggested for the treatment of symptomatic spondylolisthesis. Posterolateral fusion is a satisfactory and wellestablished method of treatment. Most authors agree that it is a safe and reliable procedure and excellent results have been obtained without instrumentation (15, 16, 27, 28, 33). However, posterior instrumented fusion with or without reduction of severe anterior displacement and lumbosacral kyphosis may prevent some of the reported complications of fusion in situ, including nonunion (3), bending of the fusion mass (3, 15) and persistant lumbosacral deformity (3, 16). Because loss of the initial correction is not uncommon after reduction (3, 4, 14), some investigators (2, 6) advocate a combined anterior and posterior fusion in conjunction with instrumentation. The rationale for anterior fusion being that it provides a mechanical support against additional slippage and maintains correction (6). In contrast to the older distraction implants (14, 20), modern pedicular fixation systems (9, 11, 35) allow rigid and stable fixation. These devices may therefore provide the opportunity to reduce and stabilize high-grade spondylolisthesis by a single-stage posterior approach (6) without the need of an additional anterior approach.

The surgical treatment of a syptomatic pseudoarthrosis in spondylolisthesis is also controversial. Reported salvage procedures include revision of te posterior fusion with or without instrumentation (7, 16), anterior fusion, or circumferential fusion from either a combined two-stage approach (6, 7), or from a single-stage posterior approach (33).

The present series rewievs an adult population with spondylolisthesis, comparing in situ posterolateral fusion with the posterior instrumented fusion. This study attempts to answer the following question: Does the use of internal fixation enhance the primary rate of fusion in this patient population?

MATERIALS AND METHODS

18 patients who were treated because of symptomatic spondylolisthesis between 1986-1993 have been retrospectively studied. There were 13 female and 5 male patients, and the mean age was 46 (range 20-63) years. The average follow-up was 3.5 (range 1.5-8) years.

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There were 2 patients with grade 1 spondylolisthesis, 9 with grade 2, 5 with grade 3, one with grade 4 and one patient with grade 5 spondylolisthesis (spondyloptosis) accompanied by a paraaortic neurofibroma. All patients failed conservative regimens consisting of anti-inflammatories, physical therapy and bracing. All patients in this study had a low back pain and a major component of leg pain distal to the knee. Eight patients exhibited weakness of the extensor hallucis longus and the remaining 10 patients had normal muscle strength. Twelve patients had decreased sensation to light touch in a dermatomal distribution. Only one patient had reflex changes. All patients had documented nerve root impingement and 7 of them had lateral recess or central stenosis exhibited by CT scan (with or without myelography) or MRI.

Patients were then separated into two groups, according to the fusion techniques. There were 10 patients in group 1 who had an in-situ posterolateral fusion without internal fixation. Two of these patients had L_4-L_5 (one had grade 1 and other had grade 2) and 8 of them had L_5-S_1 (one had grade 1, five had grade 2, one had grade 3 and one had grade 4) spondylolisthesis. The two patients with L_4-L_5 spondylolisthesis were treated with L_3-L_5 fusion. Among the patients with L_5-S_1 spondylolisthesis, 6 were treated with L_4-S_1 fusion, one with L_3-S_1 and one treated with L_5-S_1 fusion.

In Group 2 there were 8 patients in whom internal fixation was added to posterior fusion. Two of these patients had L_4-L_5 (both of thm were grade 2) and 6 of them had L_5-S_1 (one had grade 2, four had grade 3, one had grade 5) spondylolisthesis. One of the patients with L_4-L_5 spondylolisthesis was treated with a L_4-L_5 single segment fusion, while the other was treated with L_3-L_5 fusion. In patients with L_5-S_1 spondylolisthesis, one L_5-S_1 fusion and five L_4-S_1 fusions were performed.

In this group of patients, decompression was added to 3 of the cases with instrumentation and reduction was made in 4 of them. In the patient who had spondyloptosis an anterior fusion was added to reduction, instrumentation and posterolateral fusion.

All patients were immobilized in a total contact thoracolumbosacral orthosis for a minimum of 3 months. Rehabilitation included range of motion and muscle strenghthening exercise program.

Clinical outcome was graded by following criteria: Excellent - no pain or activity restriction; Good - occasional pain with no restriction; Fair - moderate pain requiring medication and limited activity; Poor - no change in preoperative pain, severe activity restriction.

RESULTS

Eight of ten (80%) patients in group 1 achieved union. Union was defined radiographically as a solid bone bridge and no motion on flexion-extension films. Two of the six L_4-S_1 fusions in this group developed pseudoarthrosis. All patients in group 2 achieved union. There was difference between the two groups. The overall combined primary fusion rate for this adult population was 89%.

Two patients (11%) had infection. Both of these patients were in group 2. In one, the infection was at the bone graft donor site that was covered with bone wax. No infection was observed at the instrumented area. Coagulase (+) Staphylococcus Aureus was cultured. Following debridement of all bone wax and antibiotics the infection resolved. The other case did not respod to repetitive debridements and antibiotic therapy. Following union the internal fixation material was removed and with subsequent antibiotic therapy, this infection also resolved.

Two patients that developed pseudoarthrosis underwent re-exploration and repair. They were revised with reduction, decompression, instrumentation and posterolateral fusion. Union was achieved in both cases. Including subsequent surgery, therefore, the overall fusion rate became 100% (18 of 18).

Radicular type pain was diminished in all patients with union. When reduction was added, low-back pain due to mechanical imbalance improved as well.

Clinical outcome was rated as excellent in 6 patients, good in 8 patients, fair in 3 and poor in one. Two of the 3 fair results had an initial pseudoarthrosis. The poor result had an initial pseudoarthrosis, too. Although, in this patient, we achieved union after a second operation, he continued to complain o persistent disabling back pain.

DISCUSSION

Although the vast majority of patients with low-grade spondylolisthesis respond to conservative treatment, nonoperative measures may not control symptoms, postural deformity, or slip progression in patients with grade 3 or 4 spondylolisthesis (31). In situ posterior fusion from the sacrum to the fourth lumbar vertebra, with or without removal of the loose posterior element of the fifth lumbar vertebra, has been the accepted standart for the surgical treatment of severe

spondylolisthesis (15, 16, 27, 28). The main argument against in situ fusion has been the reported rates of nonunion ranging from zero to 44% (3, 15, 16), slip progression rates as high as 26% despite a solid arthrodesis (3), and the persistence of the cosmetic deformity (3). Even the cauda equina syndrome has been reported after fusion in situ (29).

McAfee demonstrated that the addition of internal fixation at the time of fusion in an unstable animal model increased the rate of arthrodesis (23). The rationale for using internal fixation was to reestablish the integrity of the posterior ring defect caused by the pars defect, thereby minimizing shear forces across the disc space (18, 24, 26). Previous studies have suggested that decompression without fusion does not provide a satisfactory long-term outcome; therefore, decompression alone is not recommended in these patients (1, 10, 13, 15).

According to Bradford and Boachie-Adjei (6), reduction provides several major advantages. Reduction improves lumbosacral orientation and thereby facilitates arthoredesis and allows direct decompression of the neural elements. Correction of lumbosacral kyphosis results in spontaneous correction of thoracic lordosis and lumbar hyperlordosis. The restoration of alignment in the sagital plane allows the patient to stand fully upright with the knees and hips extended. Thus, several authors advocate reduction of severe spondylolisthesis and different techniques have been proposed (4, 5, 12, 22, 25, 26, 30, 32, 33, 37).

In our study population, the use of internal fixation enhanced the fusion. The addition of internal fixation probably was the single most important factor in improving the fusion rate.

The neurologic complication rate associated with reduction of severe spondylolisthesis has been reported to be as high as 31% (7). In our limited series of consecutive patients no neurologic complications occured. Also we had, no instrument failures or progression of the spondylolisthesis. We had two infections.

Our data also support previous findings that pseudoarthrosis adversely affects the final outcome in patients undergoing spinal arthrodesis (17, 36). Even after repair of the pseudoarthrosis half of this group continued to have disabling back pain.

The etiology of chronic back pain in spite of a solid fusion remains unknown. Postoperative fibrosis can lead to tethering and irritation of thi neural elements and progressive degenerative changes at the same or adjacent disc levels, quite possibly, factors such as these can contribute to the continued pain. Even with solid fusions, four patients continued to have disabling back pain. None of them had evidence of neural element irritation or degenerative disc disease.

CONCLUSION

In situ posterolateral fusion appears to have a higher rate of pseudoarthrosis. In cases which union is achieved, there is not any difference in radicular pain relief from those which are instrumented. Addition of reduction distinctly improves mechanical pain as well as the radicular pain. In the instrumented cases, however, the infection rate is higher.

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