Original Article

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The Results of Posterolateral Lumbar Fusion with Bone Chips from Laminectomy in Patients with Lumbar Spondylolisthesis

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Key Words
bone chips from laminectomy; lumbar spondylolisthesis; posterolateral lumbar fusion (PLF); transpedicle screws

Background. This study was undertaken to assess the radiologic outcome of spinal fusion, with bone chips from laminectomy in patients with lumbar spondylolisthesis.
Methods. From January 1993 to September 2001, 95 patients with lumbar spondylolisthesis were managed and followed up well at our Orthopedic Division. All patients presented with persistent low back pain, radiculopathy and claudication. The diagnosis of lumbar spondylolisthesis was confirmed by plain radiographs of the lumbar spine, with lumbar spine computed tomography scan (CT-scan) performed to identify other associated conditions. A near total posterior decompression laminectomy with foraminotomy and posterolateral lumbar fusion using bone chips from laminectomy as bone graft and reduction of the vertebral slip using transpedicle screws with Arbeitsgemeinschaft für Osteosynthesefragen spinal fixators and Trifix Reduction Fixation spinal system implants, were instituted. Additional disectomies were performed in several patients with disc rupture as confirmed by CT-scan. Fusion was then assessed by plain lumbar radiographs done at 4, 8, and 24 months after operation.
Results. The outcome was good, with 88 (92.6%) cases attaining solid fusion, while failed fusion was noted in 7 (7.4%) cases.
Conclusions. Proper decortication of the posterolateral vertebral gutter with removal of all soft tissues attached to the bone chips prior to the placement of bone graft were noted to be the most significant factors for spinal fusion. Fusion rate with bone chips from laminectomy was shown to be comparable to that of the iliac crest bone graft.

Spondylolisthesis, which is the forward slippage of 1 vertebra on another, it is usually due to a defect in the pars interarticularis of the lumbar vertebra. This condition was first recognized in 1782 by the Belgian obstetrician Herbiniaux,[1] and it was Rokitansky who is credited for describing the lesion as a pathological entity.[1,2] Patients with spondylolisthesis usually present with low back pain, which is dull and aching radiating down to the posterolateral side of the lower limb, increasing with activity and decreasing with rest.

Initial treatment of lumbar spondylolisthesis is usually non-operative and consists of non-steroidal anti-inflammatory drug (NSAID), refraining from strenuous activities and avoiding heavy labor. Surgical treatment is only indicated when there is persistence or recurrence of symptoms for at least 1 year, despite conservative treatment. At the present time, posterior decompression laminectomy with fusion and spinal reduction using transpedicle screws fixators is commonly used for lumbar spondylolisthesis, and the iliac crest bone graft is most widely used. However, in elderly patients with severe osteoporosis, the bone stock may not be sufficient, thus alternative bone graft (allograft or commercially available bone substitute) are used. We reviewed 95 cases of lumbar spondylolisthesis in which bone chips alone, from laminectomy, were used as graft for spinal fusion (Fig. 1). We undertook this study to assess the radiologic outcome of spinal fusion with bone chips from

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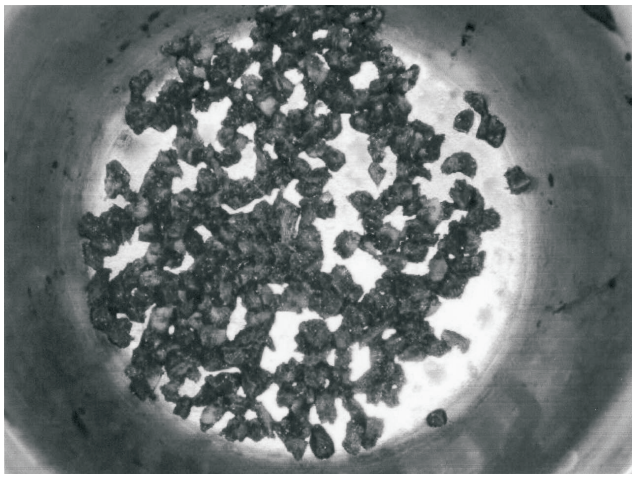

Fig. 1. Bone chip graft from laminectomy.

laminectomy in patients with lumbar spondylolisthesis.

METHODS

From January 1993 to September 2001, 95 patients (74 females and 21 males) with age ranging from 16 to 76 years of age (mean of 46 years) were admitted to our hospital with one or more of the following signs and symptoms present: low back pain with radiation to the lower limb (95/95), weakness of the lower limbs (95/95), neurologic claudication (56/95), abnormal gait (95/95) or a positive straight leg raising test (39/95). All patients met the criterion of forward slippage of 1 vertebra on another as demonstrated by plain as confirmed by plain anteroposterior and lateral lumbar spine radiographs. Associated spinal stenosis or disc rupture were verified by lumbar spine Computed Tomography-scan. There were 35 cases of spondylolyticspondylolisthesis and 60 cases of degenerative spondylolisthesis, with grades 1 - 2 spondylolisthesis of L4-5 in 79 cases and spondylolisthesis of L3-4-5 in the other 16 cases. Associated spinal stenosis was confirmed in 56 cases and ruptured disc in 39 cases.

All patients underwent a near total posterior decompression laminectomy with foraminotomy, posterolateral lumbar fusion using bone chips from laminectomy as bone graft and spinal reduction by transpedicle screws with Arbeitsgemeinschaft für Osteosynthesefragen spinal fixators and Trifix Reduction Fixation spinal system implants. All the soft tissues attached to the bone fragments were removed and the fragments were cut into chips with a ronguer. Proper decortication of the posterolateral vertebral gutter was performed prior to graft placement. Approximately 20 mg (± 5 mg) of the bone chip graft were implanted for 1 level lesion and about 30 mg (± 5 mg) were placed for 2 level lesions. Information concerning the outcome of fusion was collected from reports of plain lumbar spine radiographs done during follow-ups at 4, 8 and 24 months after operation.

RESULTS

All patients recovered smoothly, with average operative time for 1 level lesion being 1 hour and 15 minutes while 1 hour and 55 minutes was spent for 2 level lesions. Blood transfusion was only indicated and given to patients with 2 level lesions. Eighty-eight cases (92.6%) developed solid fusion mass at 8 months post-op, and failed fusion was noted in 7 cases (7.4%) (Figs. 2 and 3). Fusion rate for the 1 level lesion group was 92.4% (73/79) and 93.75% (15/16) for the 2 level lesion group. No complications such as wound infection and/or excessive wound pain were encountered in our series.

DISCUSSION

The term spondylolisthesis is derived from the Greek root word spondylo, meaning spine, and listhesis, meaning to slip or slide down a slippery path.[1] The lesion is usually noted at the L4-5 level and is due to a defect in the pars interarticularis. On physical examination, hamstring tightness is often noted, and local and radicular pain may be appreciated on deep palpation of the spinous process above the slip typically at L4. Diagnosis of spondylolisthesis is confirmed with plain anteroposterior and lateral lumbosacral spine radiographs. Other diagnostic studies such as myelograms, CT-scans and magnetic resonance imaging studies (MRIs), are indicated for pre-operative evaluation of possible coexisting lesions and better definition of

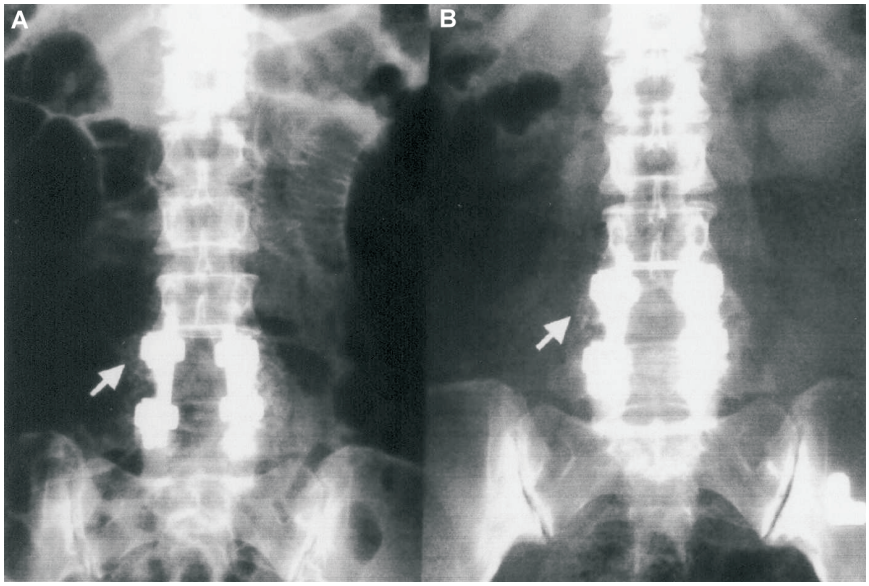

Fig. 2. (**A**) Immediate post-op anteroposterior radiograph of the lumbar spine with the bone chip graft placed over the bilateral paravertebral lumbar gutters (arrow). (**B**) Anteroposterior radiograph at 8 months post-op demonstrating a well-consolidated lateral fusion mass (arrow).

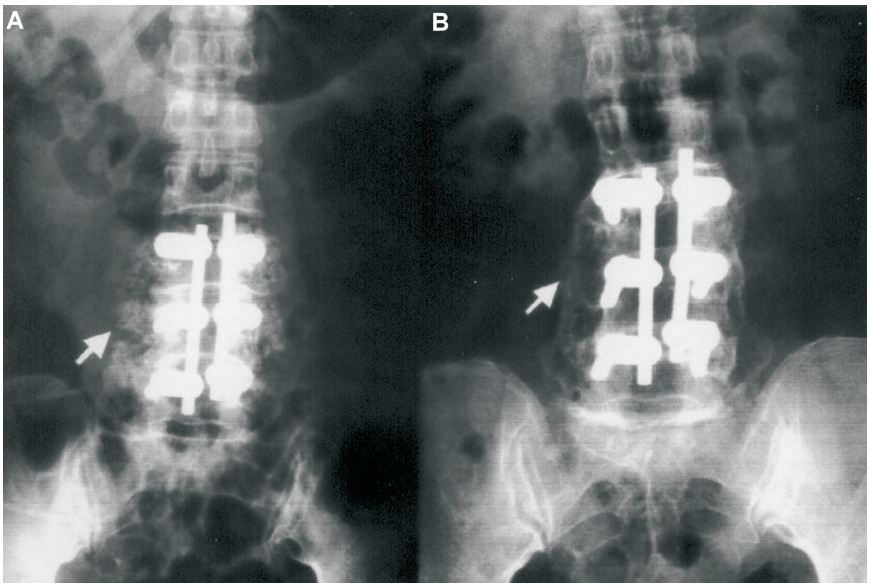

Fig. 3. (**A**) Immediate post-op anteroposterior radiograph of the lumbar spine with the bone chips graft placed over L3 to L5 paravertebral gutters (arrow). (**B**) Anteroposterior radiograph 12 months post-op with well-formed bilateral lateral spinal fusion mass from L3 to L5 (arrow).

the pathology. In 1963, in his review of 319 cases, Newman classified spondylolisthesis into 5 distinct groups, which remains widely accepted.[1,3] Since then a post-surgical category has been added. The classification is as follows: congenital (dysplastic) spondylolisthesis, isthmic (spondylolytic) spondylolisthesis, degenerative spondylolisthesis, traumatic spondylolisthesis, pathologic spondylolisthesis and post-surgical spondylolisthesis.

All authors agree that initial treatment for all types of spondylolisthesis is usually conservative, with NSAID, wearing of braces, refraining from strenuous activities

and avoidance of heavy labor. Surgical treatment is only indicated when there is persistence or recurrence of symptoms despite conservative treatment and physical therapy for at least 1 year, and for those with persistent abnormal gait or postural deformities leading to psychologic problems, progressive neurologic deficit, progressive slipping beyond 25 to 50 percent and a high slip angle of 40 to 50 degrees. Surgical treatment of spondylolisthesis consists of repair of the pars defect, decompression and *in situ* fusion.[1] With the advent of instrumentation for spinal reduction beginning in the 1960's, at present, surgical treatment of spondylolisthesis is accomplished by decompression laminectomy with posterolateral lumbar fusion and spinal reduction with instrumenatation. Fusion is achieved with bone graft commonly harvested from the iliac crest. However, in cases with degenerative spondylolisthesis, the patients usually have associated osteoporosis, and so bone stock from the iliac crest may not be enough to achieve fusion. Hence, many surgeons have switched to using allograft or to other commercially available bone substitutes. But the cost and risk of disease transmission is high compared to iliac crest autograft. Thus, another source of bone graft for spinal fusion is needed. We have therefore tried using bone chips from laminectomy as a source of graft for spinal fusion and the initial results have been encouraging. Since it is also an autograft like that of iliac crest bone, mechanism for bone growth is similar for both. Also, some authors have recently reported a high incidence of post-operative wound pain due to nerve injury following iliac crest bone graft. One other report noted iliac wing fracture after bone graft harvest. None of these complications were encountered in our series. The main advantage of bone chip graft from laminectomy over iliac crest bone graft is that the patient experiences less pain and morbidity because of absence of a donor site wound. Other advantages include shorter operative time with minimal blood loss, hence blood transfusion is rarely indicated, and less exposure time to possible contaminants in the air, with decreasing chances of wound infection. In our series, we achieved a fusion rate of 92.6% (88/95) as compared to fusion rate from iliac crest bone graft of 97% as reported in the literature. Although the results of our technique are acceptable, some cases of fusion failure were encountered. The possible cause of fusion failure was investigated, and identified to be due to improper decortication of the posterolateral vertebral gutter prior to graft implantation. All these failures occurred early in our cases, and after refining our technique by removal of all soft tissues attached to the bone chips prior to implantation of the graft with proper decortication of the para-vertebral gutter, we were able to obtain successful fusion for the rest of the cases.

In conclusion, proper decortication of the posterolateral vertebral gutter with removal of all soft tissues attached to the bone chips prior to implantation of the graft have been shown to be key factors for successful spinal fusion following posterolateral lumbar fusion in the treatment of lumbar spondylolisthesis. The fusion rate achieved with bone chips graft from laminectomy is documented to be comparable to that of the iliac crest bone graft. High post-operative wound pain and large blood loss during iliac crest bone graft in posterolateral lumbar fusion were not encountered in our patients, and they were able to return to their daily activities much earlier than expected.

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