Results of Buck screw fusion in grade I spondylolisthesis

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Summary

The results of posterolateral screw fixation using the Buck technique performed on 24 patients with painful isthmic spondylolysis and up to grade I spondylolisthesis in the lumbar spine are reported. The average age at operation was 29 years and average follow-up was 5 years with a range of 13 months to 12 years. Operations were performed for persistent disabling low back pain. At review 21 patients were either free of pain or complained of only occasional backache and discomfort. All but two patients were satisfied with the operation and rated the result as excellent or good.

It is concluded that Buck screw fixation is a safe and reliable method of treatment for painful Grade I spondylolisthesis due to isthmic spondylolysis in the young active adult with a low complication rate.

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Introduction

Spondylolisthesis was first described by Kilian[1] in 1854 as a slowly developing displacement of a lumbar vertebra and it is now generally accepted that a defect in the pars interarticularis (spondylolysis) is the commonest cause of spondylolisthesis in the older child and young adult. There has however been considerable doubt as to whether pars defects are associated with an increased incidence of back pain and Splithoff[2] indicated that the incidence of backache was no different in two separate populations, with and without defects. More recently Wiltse and Hutchinson[3] stated that the presence of pars defects increased the chances of significant back trouble by 25%. Although many patients with this condition remain symptom free throughout their life, adolescents in particular may present with acute low back pain in the early stages of slipping. Chronic low back pain is due to ligamentous strain from instability at the level of the slip. Occasionally, pressure or traction on the nerve roots at the level of the defect causes sciatica but this is rare in minimal vertebral displacement. Even more infrequently an associated bulging disc may cause nerve pressure. Several procedures have been described in the surgical management of spondylolisthesis. Loose element removal[4] was a popular operation which gave good early results but it was later observed that it increased vertebral instability and was associated with further progression of slip especially in young adults[3,5]. Its use in this age group has been generally abandoned unless combined with spinal fusion. Intertransverse or posterolateral alar-transverse fusion have been recommended for all degrees of slip and good results have been reported[3,6]. Anterior interbody fusion[7] requires a transabdominal or retroperitoneal approach and is usually reserved for severe slips.

Buck in 1970[8] described an operation designed to repair the defect in the pars interarticularis by fixing the fracture internally with a screw and supporting it with a cancellous bone graft. In his preliminary series of 16 patients followed up for a maximum of 4 years there was only one failure. Since then there has been only one brief review of 13 patients treated over a period of 8 years[9]. Since 1976 one of the authors (DJR) has performed Buck fusions on patients with spondylolysis and up to 25% (Grade I) spondylolisthesis in the lumbar spine and it was decided to review as many of these patients as possible to determine the outcome of the operations.

Patients and methods

This study was based on 24 patients who had undergone repair of pars interarticularis defects in the period 1976 to 1988. There were 15 male and nine female patients with an average age at operation of 31 years, range 13-55 years (Figure 1). All patients were reviewed at regular intervals for a minimum of one year postoperatively. Fifteen patients were examined personally by one of the authors (AVB). Thirteen of these patients had a follow-up ranging from 27 months to 12 years and the other two were reviewed at 13 and 19 months postoperatively. Nine patients who for various reasons were unable to attend the hospital were questioned about their symptoms, occupation and other activities over the telephone, the follow-up in this group of patients ranging from 5 to 12 years. Average follow-up for all patients was 5 years with a range of 13 months to 12 years.

Thirteen patients presented with low back pain of gradual onset and 11 patients related the onset of pain to a previous injury to their back. Sporting injuries, road traffic accidents and falls from heights were most commonly implicated. Thirteen of the 24 patients also complained of pain radiating to the leg. Movements of the back and straight leg raising were either full or only slightly restricted in all but three patients whose pain was sciatic in distribution. Neurological examination was normal in all patients.

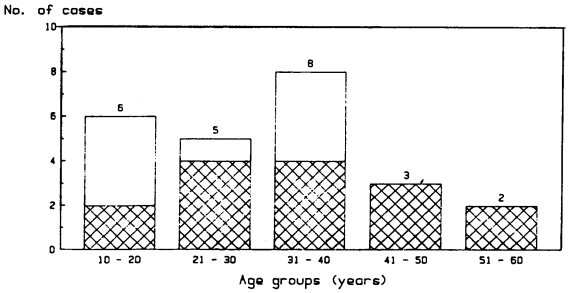

Figure 1. Distribution of patients in the various age groups (the hatched areas denote male representation)

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Anteroposterior, lateral and left and right oblique radiographs of the lumbosacral spine were obtained in all patients preoperatively. Tomograms of the lumbar spine were not requested routinely but they were very helpful in those cases where the presence of pars defects was in doubt. Bilateral pars defects were present in 22 patients and unilateral defects in two. The fifth lumbar vertebra was involved in 19 cases and defects of the fourth vertebra were present in 3 patients. One patient had defects at both L4 and L5 levels and another had bilateral defects of L3. A radiculogram or CT scan examination was performed in the three patients with sciatica. Two of these investigations were normal but one showed evidence of spinal stenosis at the site of the spondylolysis. There was no evidence of nerve root compression in any of the patients.

Surgery was performed on these patients because all had failed to respond to conservative treatment which consisted of rest, physiotherapy and corset immobilization. The mean duration of pain between onset and operation was 6 years, range 6 months to 30 years and all patients had complained of pain which was interfering considerably with their life and work.

Operative technique

All the operations were performed by a single surgeon (DJR). A midline longitudinal incision was made and instability of the affected segment was confirmed by traction on the spinous process. After pre-drilling, two screws were then passed obliquely across the defects starting at the inferior margin of the lamina as described by Buck[8]. In seven patients bone was taken from the posterior iliac crest and inserted in the defect after all fibrous tissue had been removed and the screws were then driven home distally. Stabilization of the arch complex was confirmed by traction and the wound closed without drainage. The patient whose CT scan showed spinal stenosis at the spondylolysis level underwent exploration of the space after excision of the ligamentum flavum. This however failed to reveal any cause of the stenosis and a successful screw fusion was performed.

Patients were allowed up on the second or third postoperative day and a plaster of paris or fibreglass jacket applied before discharge home. This was removed after 4-6 weeks. The average stay in hospital was 7 days (range 3-14 days) and all spines were X-rayed immediately postoperatively to check the position of the screws.

Complications

There was one significant complication in the series. This was in a patient who developed severe sciatica immediately postoperatively. Radiographs showed an incorrectly placed screw, the distal portion of which was lying inferior to the pars interarticularis in the region of the exit foramen and which had failed to pass across the pars defect. This screw was urgently removed at further operation and fortunately resulted in the patient's symptoms fully recovering. There were two superficial wound infections which resolved with antibiotic treatment.

Results

For the purpose of this study patients were classified as being pain free if they had complete relief of both back and leg pain, had returned to their previous or similar occupation and in some instances were able to engage in strenuous sporting activities. A moderate improvement indicated a moderate or complete relief of pain at rest, intermittent mild or moderate pain on strenuous activity and ability to return to full or part-time work. Unimproved patients had symptoms similar to those existing before operation whilst patients were considered to be worse if their symptoms were made worse as a result of the operation.

At review eight patients were totally pain free and 13 patients were moderately improved, their main complaint being of occasional backache. Three patients whose main complaint preoperatively was leg pain continued to experience this pain after the operation. One of these patients had however been pain free for 6 months postoperatively until he injured his back in a road traffic accident. None of the patients complained of any sensory disturbance in the legs and in the 15 patients examined the average straight leg raising was 80° and there were no neurological abnormalities. Two patients complained of tender scars.

Seventeen of the 24 patients had radiographs of their spines performed at an average of 4 years postoperatively (range 13 months to 12 years). Radiological evidence of bony fusion across both pars defects was present in seven cases (Figures 2 and 3). There was bridging of one gap only in five cases and no evidence of healing in five of the spines. There was no increase in forward slip in any of the radiographs examined. Evidence of screw loosening, determined by the presence of bone resorption around the tip of the screw, was present in five patients. In one patient, radiographs taken 13 months postoperatively showed one of the screws to be broken. This was an incidental finding and it is not known when the breakage occurred. He was however asymptomatic and both of the pars defects had healed.

At review eight patients were employed in heavy manual work, 10 in light manual work and six in

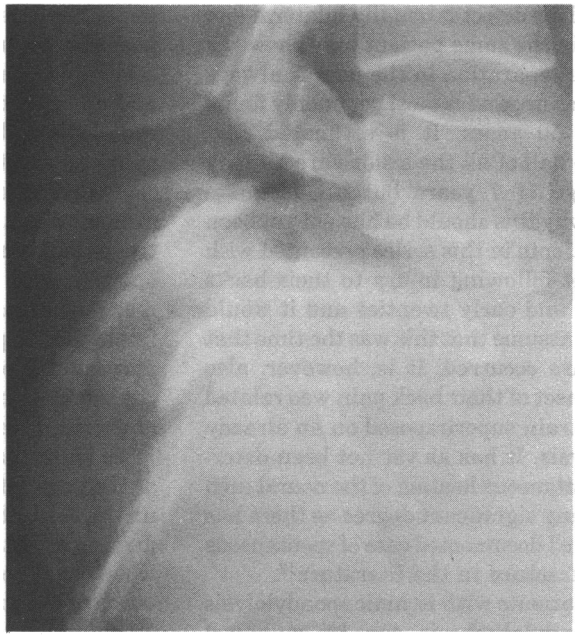

Figure 2. Preoperative radiographic appearance of isthmic spondylolysis of L5 in a 28-year-old man who had complained of increasing low back and right buttock pain over a 2-year-period

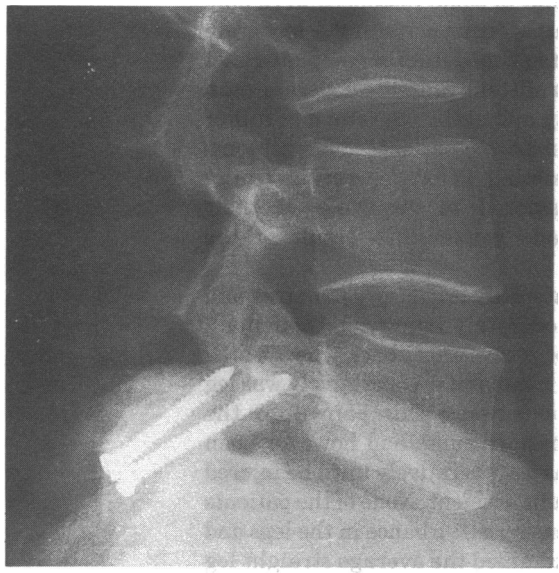

Figure 3. Complete healing of the defect shown in Figure 2 2 years following Buck screw fusion (without bone graft). There has been no increase in slip and the patient is completely asymptomatic

sedentary work. No patient had required to change occupation following the operation but two of the patients who complained of leg pain had lost a total of 5 weeks off work in the year prior to review. Twenty-two patients rated the overall result of their operation as excellent or good and several of them stated that the procedure had improved their quality of life and that they were able to partake in vigorous sporting activities. Two of the three patients who have continued to complain of leg pain since the operation have been helped by epidural steroid injections. No patient has required or is awaiting further spinal surgery.

Discussion

A defect in the pars interarticularis is responsible for the majority of cases presenting with grade I spondylolisthesis. This defect is usually bilateral and several vertebrae in the same patient may show the abnormality[10]. The separation in the pars is always due to a fatigue fracture, and is most commonly found below the age of 50 years. It is estimated that approximately one half of all the lesions are already present by the age of 7 years but an adequate explanation as to why this should be has not yet been given[11]. Eleven patients in this series presented with pain of acute onset following injury to their backs during their teens and early twenties and it would seem reasonable to assume that this was the time that their stress fracture occurred. It is, however, also possible that the onset of their back pain was related to an acute back strain superimposed on an already present spondylolysis. It has as yet not been determined whether spontaneous healing of the neural arch fracture occurs to any significant degree as there has been only one isolated documented case of spontaneous healing of a pars fracture in the literature[12].

The majority of patients with isthmic spondylolysis and Grade I spondylolisthesis can be managed conservatively with physiotherapy and in the acute episodes with bed rest and a lumbosacral support. Surgery is only indicated for the relief of chronic disabling pain or neurological compression. As slip only very rarely progresses in adulthood one should never operate on an adult believing that something should be done to prevent increase in slip. When slip does occur the increase is small and does not require surgery[3].

Direct repair of the defect in spondylolisthesis was first suggested by Buck in 1970[8]. The operation, which avoids spinal fusion and which does not involve entrance into the spinal canal, aims to restore normal anatomy by stabilizing the posterior vertebral segment thus preventing further slip. Technically the operation is not difficult to perform and with experience the total operating time is usually about one half hour. It is however important to ensure that both the drill holes and the screws are correctly placed at the first attempt and that the screws get good purchase of both cortices of the pars distally. The majority of patients in this study complained of pain for an average of 6 years before surgery and 5 of these patients had experienced pain for a period in excess of 10 years. It is our impression that very few, if any, patients experience a significant improvement in their symptoms once these have failed to respond to conservative treatment over a one year period and it is reasonable therefore to offer surgery to this group of patients.

Leg pain radiating down as far as the knee disappeared in most of the patients postoperatively. We found that leg pain in the absence of limited straight leg raising and other neurological signs was never associated with nerve root irritation or compression and is probably referred pain from the lumbar spine. Further investigation of the leg pain is therefore not necessary before proceeding to screw fusion. A radiculogram or CT scan is however considered essential in the presence of root tension signs to exclude nerve compression by any cause including a rare bulging disc. Edelson and Nathan[13] also suggested that the spinal nerve may become hooked around a deficient lamina in the presence of spinal stenosis due to a fibrocartilaginous mass thereby causing nerve tension.

Careful selection of patients and procedures is important and Buck fusion should be reserved for patients whose pain is arising solely from the unstable posterior segment and whose radiographs show no other abnormality apart from the spondylolytic defect and up to grade I spondylolisthesis. The presence of radiological disc space narrowing in the lumbar spine in addition to the pars defects is a relative contraindication for the operation since it is extremely difficult if not impossible to determine the source of the pain. Screw fusion alone is also an inadequate operation in the presence of a combination of mechanical instability and nerve root irritation as it might lead to persistent leg pain postoperatively. We agree with Henderson[14] who suggested laminectomy combined with posterolateral fusion as the procedure of choice in this situation.

We found that the presence of cancellous bone graft at the pars defects did not influence the rate of bony union. Enough bone dust is perhaps produced during drilling to act as a bone graft in some patients and when combined with stabilization of the defect allows union of the stress fracture to take place. Eight of the 12 patients in whom fusion of at least one defect was present had not had grafting performed. There was also no relationship between non-union and the age or sex of the patients. In addition the presence of visible gaps in the pars even 12 years following

operation did not seem to be associated with persistent or increased symptoms. More important however was the presence of screw loosening as none of the 5 patients in whom it was present were completely free of pain, indicating some persistent movement at the site of the defect. Interestingly two of these patients' radiographs also showed clear healing of the defects. Lag screws were not used throughout the series because it was felt that too much strain would have been put on them when the defects were compressed, perhaps causing them to break or loosen before healing was complete.

The conclusion of this study is that most patients are very satisfied with the operation and that the Buck screw fusion is a safe, reliable and simple method for the treatment of symptomatic Grade I spondylolisthesis in young active adults who wish to return to heavy work and sporting activities. Posterolateral inter-transverse or alar-transverse fusion, with their more unpredictable results, should be reserved for cases in whom there is evidence of pain originating from mechanical instability as well as nerve root compression.

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