Direct repair of spondylolysis

Bernard Jeanneret

Department of Orthopedic Surgery, Kantonsspital, CH-9007 St Gallen, Switzerland
Tel +41-71 261111. Fax +41-71 262873

The vast majority of people with isthmic spondylolysis are asymptomatic. Spondylolysis with or without spondylolisthesis, however, may be the cause of back and/or leg pain. Both are usually responsive to conservative treatment. In a small percentage, intractable back and/or leg pain may be unresponsive to conservative treatment and operative treatment may be considered. While leg pain with neurologic deficit may be due to disc herniation or the so-called far-out syndrome which both require decompression and stabilization, back and referred pain are usually treated with anterior and /or posterior fusion. This treatment gives good results in about 75 percent. As a result of the fusion, the motion segment L5/S1 is no longer mobile and degenerative changes may occur later at the adjacent motion segment. An alternative treatment was proposed in 1968 by Kimura (14) who described the direct repair of the lysis for the treatment of pain due to spondylolysis. This technique has the advantage of preserving motion in the affected motion segment. Kimura used bone graft without internal fixation. The patients were confined to bed for 2 months and wore a corset for an additional 4-6 months. Buck (5, 6), 2 years later, described a bilateral lag screw fixation technique (Figure 1A) which allowed early mobilization and was subsequently used by other authors (2, 8, 12, 17, 19, 20, 21, 22, 23). In 1982, Bradford (3, 4) described a technique proposed earlier by Scott, using internal fixation of the lysis with cerclage wires (Figure 1B). In 1984, Morscher (16) published a technique using hooks placed underneath the lamina and fixed to the vertebra by a lag screw (Figure 1C, 2, and 3).

The purpose of this paper is to describe the operative technique of pars defect repair, to present our results, to review the clinical experience and to discuss the indications for this procedure.

Operative technique

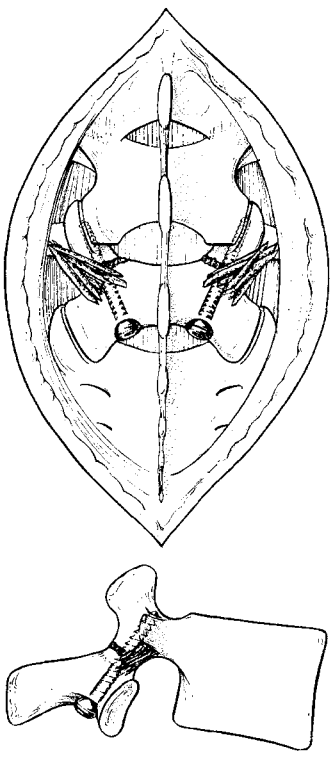
We prefer the AO-hook screw technique as described by Morscher (Figure 1C, 2, and 3) (10, 16): It is both versatile and stable. Compared to Buck's technique, the Morscher technique can be used even in presence of a dysplastic vertebral arch and does not rely on the frequently encountered very small transverse processes as does the wiring technique.

Technique; The patient is placed prone on a Relton-Hall frame. A midline approach is used: the spinous process, lamina, and base of the transverse processes of the lytic vertebra are exposed subperiostally. The lysis is prepared by removing fibrous tissue in and around the gap. The bony elements on both sides of the lysis are decorticated to assure bony healing of the lysis after pars repair. Internal fixation is now performed. A modified Harrington hook (Figure 1C) is placed bilaterally under the lamina and fixed to the pedicle of the lytic vertebra with a screw. This screw has been specially designed and has a thread of 20 mm. The entry point of the screw is located at the base of the superior articular facet of the lytic vertebra, just cranially to the lysis, midway between the medial aspect of the pedicle and the lateral border of the articular process. The screw crosses the pedicle in a caudocranial direction and exits the pedicle cranially, just posteriorly to the junction with the vertebral body. After the hook has been inserted over the screw and placed around the lamina, a spring and a nut are inserted bilaterally and provide continuous compression on the lysis for weeks after the primary compression load has decreased. Cancellous bone graft is placed into and laterally to the lysis, between the base of the transverse process and the lamina. To prevent impingement with the isthmus, the caudal tip of the articular process of the adjacent superior vertebra is chiselled off. The wound is closed in layers with suction drainage. The patient is allowed to get up the second day after surgery with a corset for 3 months.

Patients and results

Between 1975 and 1991, direct repair of pars interarticularis defect was performed in 13 patients. Eleven patients had a chronic pars defect (spondylolysis), 2 patients had an acute bilateral traumatic fracture of the isthmus.

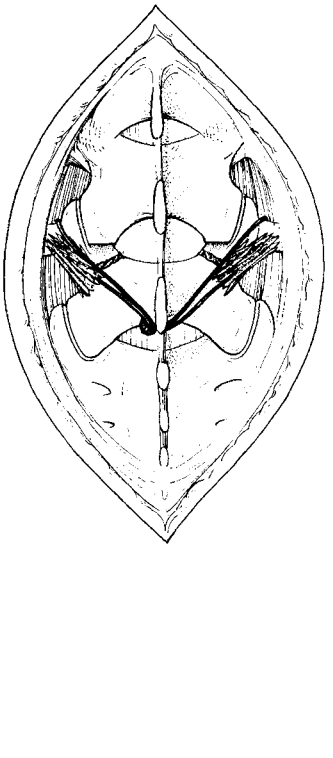
Figure 1. Pars fixation techniques.



Lag screw fixation as described by Buck (1970). The 3.5- mm cortex-screws enter the lamina at its inferior edge, 7–10 mm medial to the adjacent intervertebral joint, aim towards the pars defect which is crossed and enter the pedicle at the level of the defect, midway between the lateral and medial border of the pedicle.

Cancellous bone graft is placed into and laterally to the lysis, between the base of the transverse process and the lamina. To prevent impingement with the isthmus, the caudal tip of the caudal articular process of the adjacent superior vertebra is chiselled off.

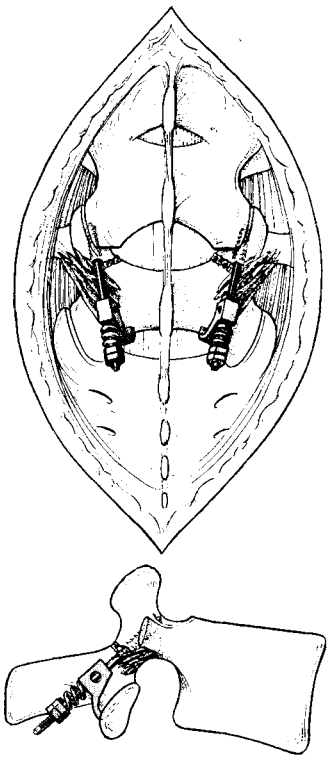
Lag screw fixation is only possible if the bony elements are broad enough to accept a 3.5-mm screw. Smaller screws may break.



Segmental wire fixation as proposed by Scott (1977) and described by Bradford (1982). A cerclage wire loop is inserted on both sides around the transverse processes of the lytic vertebra, passed caudally of its spinous process and tightened together with the wire of the contralateral side.

The same bone grafting and chiselling off as in lag screw fixation is done.

The wiring technique has the disadvantage of relying on sometimes very small and weak bony elements, the transverse processes. Furthermore, the iliotransverse ligaments have to be transsected for a lesion at the level L5. This may lead to a further destabilization of L5.



AO-hook screw fixation as described by Morscher (1984). The modified Harrington hook is placed under the lamina of the lytic vertebra and fixed to its pedicle with the specially designed screw with a thread of 20 mm. Compression is achieved with a spring and one or two nuts which provide continuous compression on the lysis for weeks after the primary compression load has decreased.

This technique can be used even when the posterior arch is very thin and dysplastic. It provides optimal stability and allows positioning of bone graft into the lysis while in the Buck's technique, the screws cross the lysis itself and prevent adequate placement of bone graft. The AO-hook screw fixation can also be used for osteosynthesis of a traumatic spondylolysis.

The 11 patients with spondylolysis were controlled. In all patients, A-P and lateral radiographs as well as flexion/extension views were performed. A pars defect was considered to be healed, if the metal implants were intact and remained in unchanged position in the flexion and extension views in relation to the repaired vertebra.

The 11 patients (8 men, 3 women) were on average 26 (15–51) years of age at the time of surgery. Only 4 patients were older than 20. All patients had disabling back pain, twice associated with radicular leg pain due to a L5/S1 disc herniation. The spondylolysis was located at L5 in 9 patients, at L4 in 1 and both at L3 and L4 in 1 patient. No slip was present in 4 patients and in 7 patients, the slip varied between 5 and 25%. 2 patients presented with a herniated disc L5/S1 together with a lysis at L5.

Treatment; The spondylolysis was repaired 6 times according to Morscher's technique and 5 times according to Buck's technique. In 2 patients (aged 29 and 51), a herniated disc L5/S1 was removed at the same time. Postoperatively, the patients were allowed to get up between the first and third day and wore a corset for 3 months.

Figure 2. A 18-year-old cheesemaker with back pain during heavy lifting.

Spondylolysis L3 and L4 (arrows), no slip.

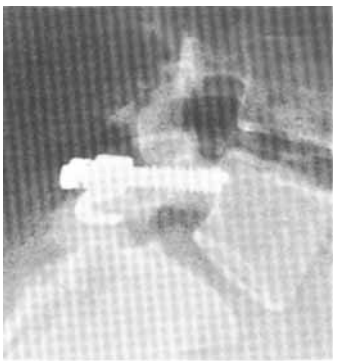
MRI shows normal disc L3/4 and L4/5 in the T2 weighted sequence.

3 years after pars repair with AO-hook screws. The defects are healed and the metal is stable.

The flexion (and extension) view show good motion of the lumbar spine. The patient was pain free.

Figure 3. A 14-year-old ice dancer with back pain during sports activity.

Spondylolysis L5 with slight slip of L5 over S1; Grade I.



4.5 years after surgery, the girl was absolutely pain free and professional ice dancer. The metal is stable.

Results; At follow-up (average 6 [1–17] years) after surgery, 9 pars repairs were healed. In 2 patients, the screws were broken and the pars defect pseudarthrotic. Their clinical outcome was fair and bad in one case each.

The clinical result was good or excellent in 7, fair in 2 and bad in 2 patients. In these last 2 patients, the preoperative pain pattern was unchanged: 1 patient presented a nonunion, in the other patient, the pars defect was healed. The clinical outcome was not dependent on the amount of slip.

Discussion

According to the literature, direct repair of spondylolysis gives good results in 60–90% (Beckers 60% (2), van der Werf et al. 66% (23), Hefti et al. 79% (10), Pedersen and Hagen 83% (20), Louis 86% (15), Buck 1979 88% (6), Albassir et al. 90% (1), Ohmori 90% (19)). In our series, very good results were achieved in 7 out of 11 patients (63%). In two patients, the clinical result was fair (one had a nonunion), and in two others patients, the clinical result was poor (one had a nonunion). The clinical outcome was not dependent on the amount of slip (0–25%). Our experience is small, but fits with the figures given in the literature.

According to the literature, the results depend a) on the age of the patients, b) on the degree of degeneration of the intervertebral disc involved and c) on the healing of the pars defect.

While some authors have reported good results with direct pars repair even in older patients (2, 9), other authors (1, 10, 13, 24) have shown, that patients older than 20–30 years of age have a worse outcome than younger patients and therefore should not undergo direct pars repair (4, 10). Hefti et al. (10) had good results in 88% of patients younger than 20 years of age, while patients older than 20 years of age had good results in only 71%. In our series, 4 of 11 patients were older than 20: 2 had a very good and 2 a fair result. This small experience shows that even older patients may benefit from this technique. However, it does not invalidate the theory that younger patients have a better clinical outcome than older, what seems logical.

No intervertebral disc pathology or arthritic changes should be present (1, 6, 19, 22). The intervertebral disc must show normal hydration on MRI. If operative treatment is indicated in patients with spondylolysis associated with degenerative disease, then a fusion operation should be performed. A slight slip on the other hand does not seem to compromise the patients outcome (7, 13, 23). Hefti et al. (10) did not find any difference in the results between patients with no or with minimal slip of up to 5 mm. Other authors even promote direct pars repair of up to a 25% slip (1, 8, 20). In our patients, the clinical result between patients with 0 and 25% slip did not differ.

The results are also dependent on the healing of the pars defect which occurs in about 83% (1, 18). Bilateral nonunion seems to be a cause for bad results (1, 2). In our series, we had two nonunions, one with a fair and one with a bad result.

Conclusion

The direct repair of a pars defect is an elegant method for stabilization of a painful lytic segment (up to a 25% slip). It shows good results if used in patients under the age of 20, without slip and without degenerative changes in the affected intervertebral disc. However, even older patient may benefit from this procedure. The results are comparable to those achieved by a fusion operation (11), however, the technique is simpler and less invasive while preserving motion in the segment affected.

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