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REVIEW ARTICLE

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Translaminar screw fixation in the lumbar spine: technique, indications, results

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Abstract Translaminar screw fixation of the lumbar spine represents a simple and effective technique for short segment fusion in the degenerative spine. Clinical experience with 173 patients who underwent translaminar screw fixation revealed a fusion rate of 94%. The indications for translaminar screw fixation as a primary fixation procedure are: segmental dysfunction, lumbar spinal stenosis with painful degenerative changes, segmental revision surgery after discectomies, and painful disc-related syndromes such as internal disc disruption and lumbar disc herniation with concomitant degenerative changes. As an additional stabilization procedure, translaminar screws can be used to augment anterior fusion or reinforce pedicle systems. Translaminar screw fixation achieves as high fusion rate provided the biomechanical principles of the lumbar spine with an intact anterior column are respected and a meticulous operative technique is employed to enhance bony ingrowth of the graft.

Key words Translaminar screw fixation · Lumbar spine · Posterior fusion · Indications

Introduction

Fixation of the lumbar and lumbosacral spine with pedicle screws is presently the most common technique for internal fixation in the lumbar spine, and has been widely used for a variety of indications for almost 30 years [26, 27, 35]. However, the use of posterior internal fixation to increase fusion rates was first attempted, to our knowledge, as early as 1891, when a wiring technique for spinal fusion was introduced by Hadra [14]. Reports of various techniques with different implants were published in the following years. The use of facet screws was first reported by King in 1948 [24], whose technique was to immobilize the lumbosacral joints with a short screw, transversing the facet. With his technique, he achieved a fusion rate of 91% without prolonged rigid external fixation postoperatively. Boucher [4a] reported a slightly different technique of screw insertion. He tried to improve the bony purchase by penetrating the ipsilateral pedicle with the tip of the screw. Using this technique, he considerably improved the fusion rate, which he reported as 100% in single-level fusions. However, the tip of the screw had to be placed near the foramen and the nerve root, which carries potential risk of injury.

Another modification of the technique of transfixing facets with screws was introduced by Magerl in 1984 [27]. Magerl's idea of inserting the screw from the contralateral side, through the lamina, eliminated the disadvantages of the former techniques without losing their advantages. Bony purchase was increased by the passage of the screw through the lamina, and the procedure is less risky, as (1) the insertion of the screw is clearly posterior to the neural elements and can be performed under direct visual control, and (2) the direction of the screw is parallel to the exiting nerve root.

The present review is based on a vast experience covering 15 years of clinical application of translaminar screws. It focuses on the indications, advantages, and contra-indications of this technique.

The facets of the lumbar spine

A simplified but practically useful concept of the anatomy of the spine is the three column model as conceived by Louis [26]. The anterior column is represented by the disc and vertebral body and the two posterior columns by the facets. In the path of evolution, anatomy was molded according to the physiological requirements of the spine, and it is reasonable to assume that the facets were placed at a mechanically important strategic point.

The importance of the facets has been demonstrated in several in vitro experiments, in which partial or total resection led to dysfunction of the functional spinal motion unit [1, 15]. Together with the intervertebral disc, the facets share and support the axial load of the spine. Although the disc appears to be the primordial load bearing structure [15], the facets, as an indispensible part of the three column concept, transmit part of the load, which varies according to the position of the individual [10, 39]. Structural and morphological changes, with destruction of cartilage and osteophyte formation, underline the strategic mechanical position of the facets. As the load passes partially through the facets, the lever arm acting on an immobilizing internal fixation device within the area of the facets remains short. A low-profile fixation is sufficient to block the segment efficiently to enhance solid bony fusion [17, 25].

Operative technique

The principle of this technique involves screw fixation of the facet joints in order to facilitate calcification of the bone graft [2, 28].

The exposure is done through a standard midline incision. The spinous processes, the lamina, the facet-joints, and laterally the transverse processes are visualized and decorticated to receive the bone graft. The joints are opened by excision of the capsule. Osteophytes are removed. The cartilage of the dorsal aspect of the joint may be removed, taking care not to injure the hard subchondral bone in order to avoid loss of screw fixation.

Insertion of the screws by the Magerl technique is performed from the contralateral side of the spinous process of the segment to be fused, taking advantage of the firm hold of the screw – usually a 45-mm AO screw, 50–54 mm in length – in the intact laminar bone. Using a 3.2 mm AO drill bit, a hole is bored from the contralateral side of the spinous process into the opposite lamina. From there, the drill crosses the facet joint through its center and stops at the base of the transverse process. This technique allows a favorable screw direction, almost perpendicular to the plane of the joint to be fused. In obese patients, percutaneous insertion of the drill through a separate stab incision may be necessary to obtain the proper direction. A dissector may be introduced between the attachment of the ligamentum flavum and the lamina, thus avoiding penetration of the spinal canal during the drilling procedure. An iliac bone graft has to be placed posteriorly along the bony structures previously carefully decorticated (Fig. 1).

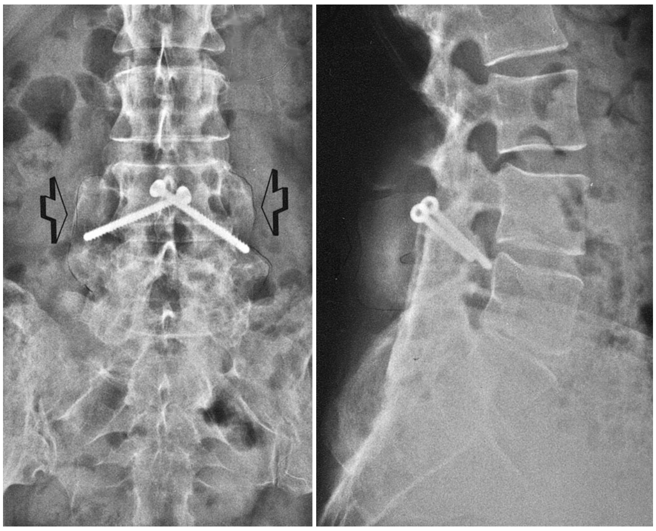


Fig. 1 Bone graft is essential for permanent solid fusion. Posterolateral, intertransverse only of graft in combination with posterior interspinous bone graft offers a stable bony three-point fixation

By applying interspinous distraction, the foramen can be enlarged by up to 30% [22]. If the screws are inserted while the distractor is in place, permanent distraction will assure foraminal widening. Although kyphotic deformity in the lumbar spine is to be avoided, moderate segmental kyphosis did not affect the clinical outcome.

Postoperative management is simple. Mobilization is begun on the 1st or 2nd postoperative day. A soft brace is worn out of bed for 3 months to restrict gross motions. Patients are instructed how to move "en bloc" and encouraged to walk; no physical therapy is performed during the first 2 months.

Patients

Between 1987 and 1990, 173 consecutive patients (94 females, 81 males) underwent translaminar lumbar fusion. Of these 173, 145 patients (83%) were clinically and radiologically reassessed by investigators unaffiliated to the department. The average follow-up was 58 (42–71) months. Mean age at the operation was 53 (22–87) years.

Seven patients (4%) died during the follow-up period; however, no cause of death was related to spine pathology. Twenty-one of the patients (12%) were lost to follow-up.

Ninety-nine patients (57%) had a single-level fusion, 70 patients (40%) had a two-level fusion and 4 patients (2%) had a three-level fusion. Apart from the spinal fusion, a nucleotomy was performed in 52 patients (30%), additional bony decompression and widening of the spinal canal was performed in 90 patients (52%).

Mobilization with a soft brace was started on the 1st postoperative day. Physiotherapy was initiated only after 6–8 weeks postoperatively, in order to protect the calcification of the graft.

Table 1 Indication for translaminar screw fixation in 173 consecutive patients

Indication	*n*	%
Spinal stenosis	62	36
Herniated discs	38	22
Reintervention	30	17
Degenerative changes	27	16
Lumbosacral anomalies	10	6
Traumatic/post-traumatic changes	6	3

Table 2 Clinical results of translaminar screw fixation in the 173 patients by number of levels fused

No. of levels	Clincial results		
	Good	Fair	Poor
1 (*n* = 99)	63 (64%)	23 (23%)	13 (13%)
2 (*n* = 70)	43 (61%)	20 (29%)	7 (10%)
3 (*n* = 4)	2 (50%)	1 (25%)	1 (25%)

Clinical investigation with local and neurological assessment was performed. In addition, patients independently filled out a form about their postoperative course prior to the medical examination. Pain was rated using a visual analog pain scale (VAPS), from 0 (no pain) to 10 (unbearable pain). The radiological assessment of a total of 251 instrumented segments in 173 patients was done by antero-posterior and lateral X-rays of the lumbar spine and by means of flexion/extension films that were digitized in order to detect pseudarthrosis.

Results

A solid bony fusion with a radiologically calcified fusion mass and no apparent motion on the digitized flexion/extension radiographs in the fused segments was documented in 163 patients (94%) or 241 segments (96%). A radiolucent area around the screws was detected in five patients (3%). Two screws were broken; however, no motion could be detected on the flexion/extension radiographs.

Preoperatively the subjective pain rating was 7.6; this decreased to a pain rating at follow-up of 2.9. Thirty-three patients (19%) are taking analgesics because of lumbar back pain; 160 (92%) of the patients reported that they would elect to undergo the same treatment if they found themselves in a similar situation again.

Details and analysis of the results are listed below (see Indications). Tables 1–3 show the distribution of indications for surgery, and the results by number of levels fused and by indication.

Complications

Non-union was confirmed in ten patients (6%) or ten segments (4%). Among these ten patients, four had undergone two-level fusion and six single-level fusion. Reoperation for painful pseudarthrosis was necessary in eight patients (5%); translaminar screws were removed and replaced by a transpedicular fixation and augmentation of the bone graft. After this reintervention, seven patients achieved a solid fusion; one patient had to undergo a second revision because of pseudarthrosis in the same segment. An L4/5 discitis after nucleotomy and screw fixation was noted in one patient, which required operative drainage with removal of the screws. A solid fusion was documented at follow-up.

One patient experienced persisting weakness of the quadriceps muscle after fusion and decompression in L2/3, and one patient suffered temporary paresis of the long thoracic nerve, probably due to positioning during surgery. Painful transient root irritation without objective neurological signs was seen in three patients (2%). In none of these cases was removal of the screws necessary, as no conflict of the screws with the involved nerve roots could be detected on postoperative myelograms. All of these patients indicated marked reduction of the symptoms at follow-up. In five patients the implants were removed after consolidation of the fusion. Two patients had to undergo wound revision after 12 and 15 days respectively, due to secondary wound healing.

One dural tear occurred during a decompressive procedure, which was sutured without any further sequelae, and in one patient a wrong level was fused, which had to be reoperated, with a good final outcome.

General complicatons were seen in five patients: two deep vein thromboses, which required prolonged bedrest and intravenous anticoagulation, one postoperative pneumonia and seven urinary tract infections, which were successfully treated with antibiotics.

Indications

Translaminar facet screws can be applied as a primary fixation or as an additional procedure to protect and augment an existing fixation.

Translaminar screws as primary fixation

Segmental dysfunction

Motion between two or more anatomical structures causes wear and tear and a gradual change in their micro- and macrostructure, which may or may not lead to altered function, possibly associated with pain [7]. This statement

Table 3 Clinical results by indication

Indication	Clinical results		
	Good	Fair	Poor
Spinal stenosis (*n* = 62)	49 (79%)	8 (13%)	5 (8%)
Herniated discs (*n* = 38)	29 (76%)	7 (18%)	2 (6%)
Reintervention (*n* = 30)	13 (44%)	10 (33%)	7 (23%)
Degenerative changes (*n* = 27)	22 (81%)	2 (8%)	3 (11%)
Lumbosacral anomalies (*n* = 10)	4 (40%)	4 (40%)	2 (20%)
Traumatic/post-traumatic changes (*n* = 6)	4 (67%)	1 (16%)	1 (16%)

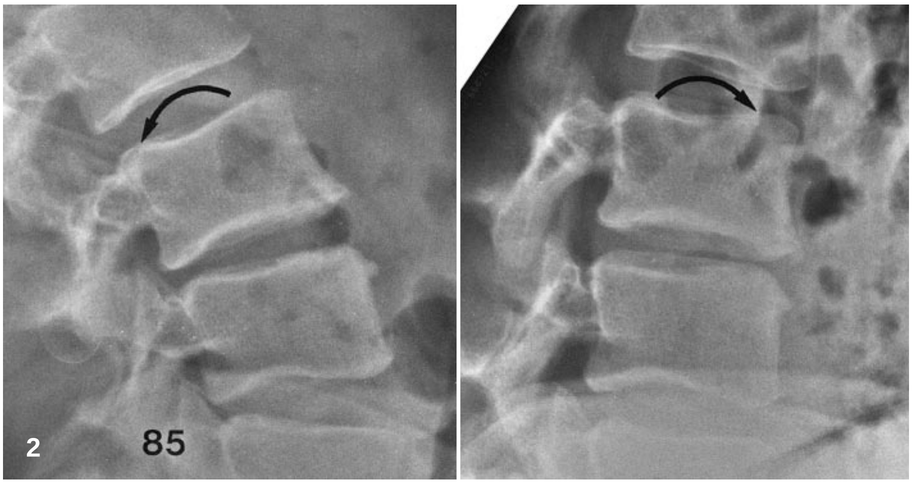


Fig. 2 Painful degenerative changes in the L4/5 segment was treated with translaminar screw fixation

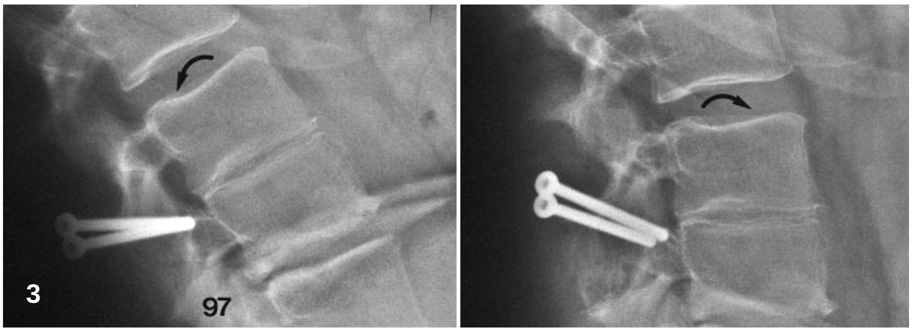


Fig. 3 Same patient as in Fig. 2, 12 years later. The disc space of the fused segment narrowed considerably and calcified spontaneously as a consequence of effective immobilization of the anterior column by the facet screws

applies not only to the whole locomotor apparatus, but specifically to the spine and the complex architecture of the spinal motion unit. According to this view, pain generation from a motion segment of the lumbar spine is not something specific to the axonal organ, but is merely a common response of biology. However, given the complexity of the spine, diagnosis and localization of the pain source remains a challenging problem. Apart from clinical and radiological examination [33], facet blocks and discography may be helpful in determining the involved segment. Temporary fixation with the external fixator can also be used as an invasive diagnostic method [30]. In spite of these sophisticated investigational methods, many unsolved parameters remain to be solved. Many attempts have been made to correlate objective biomechanical, radiological, or clinical data with "instability", but no final conclusion can yet be made. In our practice, we consider repeat facet blocks with consecutive pain relief or discograms with positive memory pain provocation as valuable indicators for identification of the pain source.

Once the diagnosis of the painful segmental motion is established, posterior immobilization with translaminar screw fixation seems a simple and effective procedure for selective fusion of the involved segment, and is likely to relieve symptoms [37]. The dysfunction of a segment without macroscopic structural changes represents an ideal indication for translaminar screw fixation (Figs. 2, 3).

Patients and results

In our series, 27 patients (16%) underwent posterior fusion due to segmental dysfunction. All patients underwent extensive diagnostic procedures with conventional radiographs and CT or MRI. Facet injection (23 patients) and discography (5 patients) were performed to confirm the pain source. The overall results were rated as good in 81% (22 patients), as fair in 8% (2 patients), and as poor in 11% (3 patients). Radiologically there was a solid fusion with no apparent motion in the functional radiographs in all but one patient. This pseudarthrosis was reoperated successfully by posterior transpedicular fixation technique.

Lumbar spinal stenosis

Degenerative lumbar spinal stenosis can be effectively treated with surgical decompression. If the compressive structures are removed, reduced pain and increased walking distance may be expected as a satisfactory result of the procedure [11]. For decompression, a posterior approach is generally accepted; however, the decompressive technique and the need for simultaneous fusion remains somewhat controversial. According to our previously published results [11], simultaneous fusion does not provide better results if there are no signs of obvious concomitant radio-

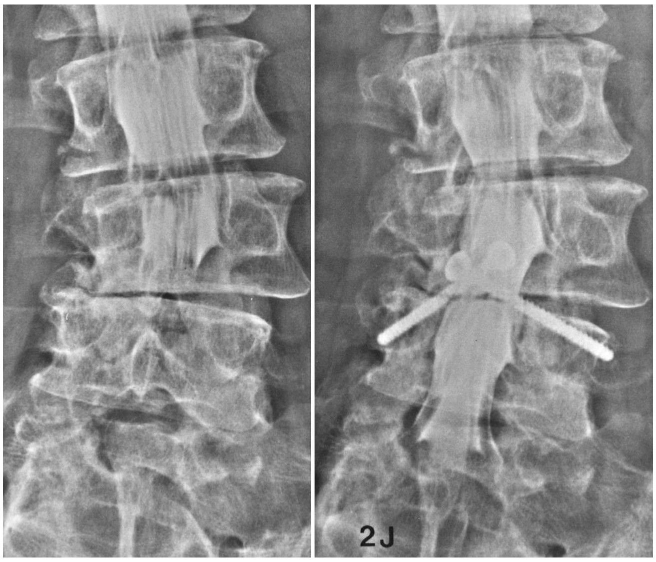


Fig. 4 Severe spinal stenosis L4/5 with rotational instability *(left)*. Follow-up film, 2 years after decompression and translaminar screw fixation, shows re-established spinal canal and immobilized L4/5 segment *(right)*

logical instability such as scoliotic deformity or degenerative spondylolisthesis. These results are supported by Herkowitz and Kurz [18], who reported a deterioration of the results in degenerative spondylolisthesis after decompressive laminectomy (Fig. 4). It is reasonable to assume that the decompressive technique influences the remaining stability of the involved segment [1]. Complete laminectomy with removal of major parts of the facets, as is necessary in mainly lateral spinal stenosis, may jeopardize segmental stability [20, 23, 32]. In these circumstances, an additional fusion should be considered. Having removed all the posterior elements, only transpedicular fixation systems are eligible. Considerable disadvantages, such as increased time of surgery and hemorrhage, increased risk of nerve injury by pedicle screws, or postoperative loosening of rigid implants in osteoporotic bone, are connected to this technique. By using the more anatomical, atraumatic, and physiological technique of “undercutting laminectomy”, an effective decompression of the spinal canal can be performed while leaving the posterior elements essentially intact [5, 6, 8, 12, 29, 36]. If fusion is considered necessary, translaminar screws offer an option of fixation with the technique of “undercutting laminectomy” without considerable risk or lengthening of the operation time.

Patients and results

Thirty-six percent (62) of our patients underwent decompression of a narrow spinal canal and simultaneous fusion with the translaminar fixation technique. The diagnosis of spinal stenosis was confirmed by the clinical symptoms, neurological investigation, and myelo-CT or MRI in all patients. The results at follow-up were classified as good in 79% (49 patients), fair in 13% (8 patients) and poor in 8% (4). The pain rating on a 0–10 VAPS was reduced from 7.3 (9.2–5.4) preoperatively to 2.5 (5.2–0.8) at follow-up. Fusion was confirmed by functional radiographs in 59 patients. One patient required revisional surgery for further decompression and stabilization. The two other patients with non-union indicated moderate back pain and refused further treatment. No progression of deformity was observed in degenerative spondylolisthesis ($n = 9$) or degenerative scoliosis ($n = 12$).

Revision surgery

Persisting or recurrent pain after decompressive procedures may be associated with mechanical problems. Scar formation or persisting bony stenosis may irritate neurological structures during motion. Immobilization of a previously operated segment may, therefore, be indicated. If there is narrowing of the foramen by a reduced disc space induced by a former discectomy, additional distraction can be used to open the foramen to its original size [22]. Resection of one facet joint or bilateral resection of more than 50% of the facet produces segmental instability [41]. As translaminar screws rely on the integrity of the posterior elements, this technique is only indicated in cases where the lamina and facet joint are substantial enough to receive a 4.5-mm cortical screw. As the posterior bone stock is reduced, careful posterolateral intertransverse dissection for the bed of the bone graft has to be done.

Results

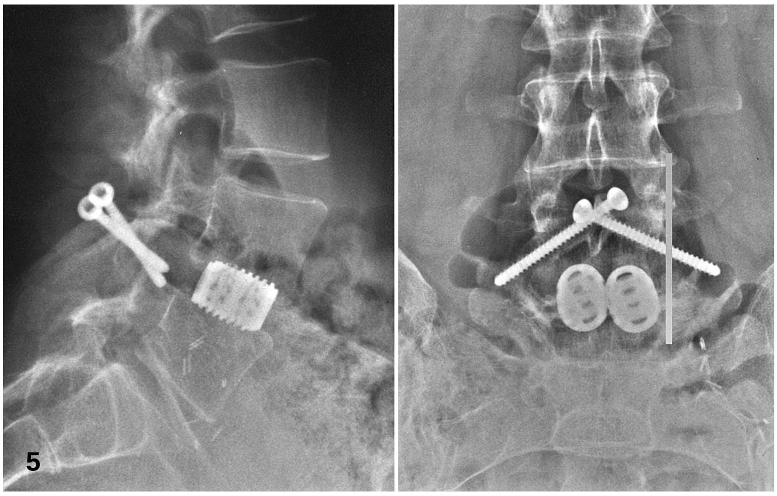
Thirty patients (17%) were fused after previous surgery of the same segment. In 21 patients, additional revision and decompression was considered necessary on the basis of the clinical symptoms. Nine patients had only back pain, which was connected to the iatrogenic instability. Translaminar facet screws were used to immobilize the segment operatively. Forty-four percent of these patients presented with a good result, 33% had a fair result, and 23% were rated as poor. Pseudarthrosis was observed in two patients, both requiring additional surgery with anterior interbody fusion.

Minor lumbosacral anomalies

Symptomatic minor lumbosacral anomalies with preserved posterior elements can be fixed with transarticular screws. In our series, radiological entities were found such as megalotransversus with and without neoarthrosis with sacrum and joint asymmetry (six patients). This is considered as one group of six patients because megalotransversus and joint asymmetry often occur together. We do not differentiate between these groups.

Results

Ten patients with the above-mentioned mild anomalies were operated, using translaminar screws to fix the lumbosacral junction.



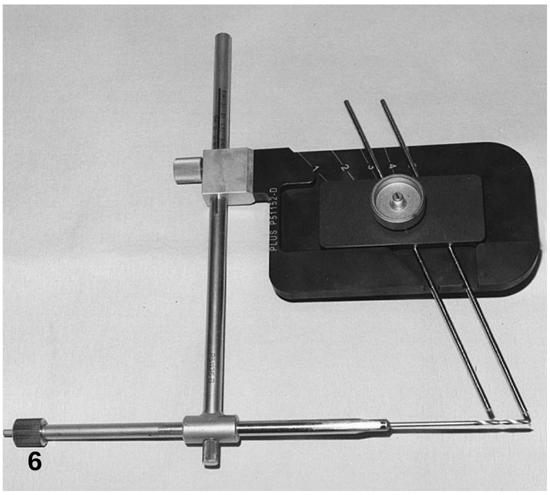


Fig. 5 Augmentation of anterior interbody fusion with threaded titanium cylinders with posterior translaminar screws. The additional posterior screws increase the stability considerably and enhance solid fusion

Fig. 6 Prototype of a device to insert translaminar screws percutaneously by a simple stab incision. The anteriorly performed, minimally invasive interbody fusion technique can be completed posteriorly

Four patients had a good and four a fair clinical outcome. There was no pseudarthrosis in this group.

Disc-related syndromes

Lumbar disc herniation: Excision of the protruding disc fragment through a limited exposure is the well-accepted therapy for herniated lumbar discs [3]. With this technique, a 5–10% incidence of recurrent disc herniation and a 10–15% incidence of postoperative low back pain is to be expected [16]. Routinely, simultaneous fusion after disc excision does not seem to be justified. However, in the presence of long-standing back pain and degenerative changes in the involved segment, additional fusion may help to achieve satisfactory operative results.

Disc resorption, internal disc disruption: Even when the underlying pathology in these syndromes is suspected to be anteriorly in the degenerated disc itself [5, 40] posterior fusion may help to relieve pain by immobilization of the segment. Posterior translaminar screw fixation is indicated if anterior surgery is to be avoided for other medical reasons or in cases where posterior bony decompression has to be performed simultaneously.

Results

Thirty-eight patients (22%) with the diagnosis of disc-related problems underwent translaminar screw fixation. Twenty-nine patients had herniated discs with significant, long-standing back pain and radiologically verified degenerative changes of the involved segment. Additional diagnostic facet infiltration confirmed the indication for fusion. Nine patients had other disc-related problems. In three patients, persisting low back pain and a positive memory pain during discography was the indication for fusion. Six patients showed disc resorption and concomitant lateral nerve root entrapment. After local decompression, additional fusion with translaminar screws was performed. Of these 38 patients, 76% had a good clinical outcome, 18% showed a fair result and a poor result was noted in 6%.

Translaminar screw fixation as an additional procedure

Augmentation of anterior fusion

Translaminar screws efficiently immobilize the posterior columns in cases where the anterior column is intact. If there is a structural deficiency anteriorly, reconstruction with a compression-resistant device has to be accomplished. Biomechanically, anterior struts are ideal for resisting compressive forces, but prove to be insufficient in neutralizing axial rotational forces. Therefore, translaminar screws are ideal for supporting and completing anterior procedures by fixing the facets, thus eliminating axial rotation. In cases where non-autologous graft material is used for anterior fusion in the lumbar spine, the screws may protect the graft mechanically until fusion occurs [19]. The anterior technique may be the “classic” open technique or a procedure with reduced exposure (laparascopically, minimally open). Recent biomechanical investigations [31] have reported on the stability of anterior interbody cylindrical cages (Fig. 5). These implants, introduced from an anterior approach with laparascopic technique or with an open minimal approach, provide stability in all directions except extension. By adding translaminar screws, Oxland et al. reported successful neutralization of this remaining instability. Stonecipher and Wright [38] recommend translaminar screws in combination with posterior lumbar interbody fusion. This augmentation of sta-

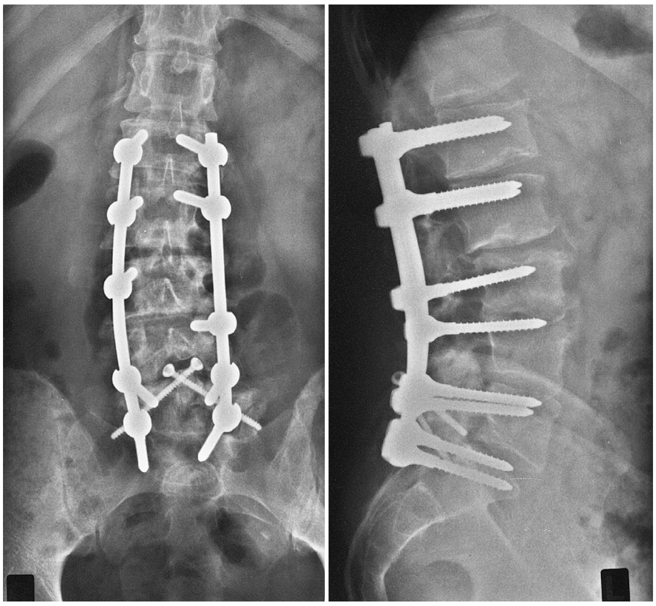


Fig. 7 Plurisegmental fixation of the lumbosacral spine creates long lever arms on the sacral screws. Translaminar screws are useful to reinforce the lumbosacral junction

bility led to solid fusion in all their 35 patients. The additional posterior procedure is traditionally performed in an open technique, but recently, a percutaneous technique has been developed. In accordance with new techniques of minimal invasive anterior fusions, the newly developed percutaneous technique for transarticular screw insertion seems to be a promising additional stabilization technique. Preliminary experiences confirm the practicability of this procedure (Fig. 6).

Augmentation of pedicle systems

The weak point of long pedicle constructs in fixation of the lumbosacral spine remains sacral fixation. Sacral pedicles are wider than lumbar pedicles, providing less solid bone for screw fixation. The additional stability achieved by supplementary transarticular screw fixation in the lumbosacral joint may help to overcome this anatomical disadvantage (Fig. 7).

Deformities

To a limited extent, translaminar screws are useful for correcting deformities of the lumbar spine. The screws can be inserted during the application of unilateral distraction, thus maintaining the reduced position. Segmental scoliotic deformities may be corrected by this technique; however, solid subchondral bone is mandatory to avoid fracture of the facets. In more complex deformities of the lumbar and lumbosacral spine, facet screws can be inserted as a preliminary fixation. Using the above-mentioned method of correction, the screws hold the reduction until the final (pedicular) implant is put in place, providing additional stability and easier insertion (Figs. 8, 9).

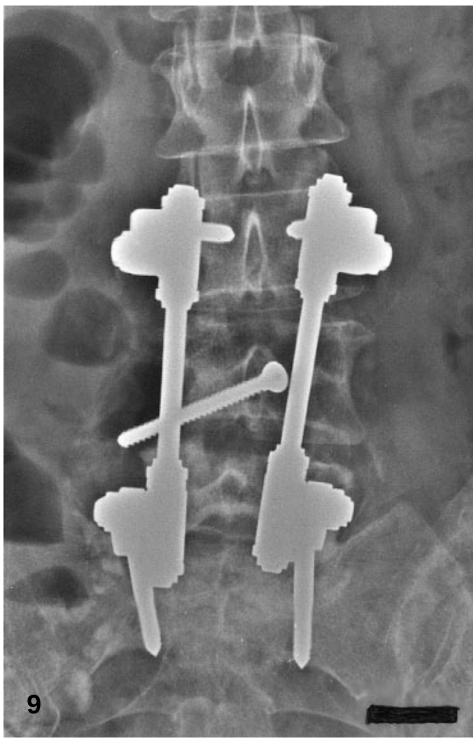


Fig. 8 Degenerative scoliosis with rotational instability at L4/5

Fig. 9 Preliminary temporary fixation and correction of the L4/5 deformity by insertion of a transarticular screw after unilateral distraction. The transpedicular system was then inserted with the spine in the reduced position

Repair of anterior pseudarthrosis

In cases of anterior pseudarthrosis, posterior additional fusion is preferable to repeat anterior procedures. Scar formation around the aorta and the iliac and cava veins may increase the risk of operating via an anterior approach considerably. Translaminar screw fixation with additional posterior bone graft offers a simple and effective method to eliminate the remaining instability.

Discussion

Mechanically stable situations offer the best conditions for solid bony union to occur. Based on this knowledge, internal fixation to reduce or eliminate motion is an established technique to achieve fusion.

The necessary level of rigidity of the fixation system has not yet been defined. From the literature, it is known that systems of different rigidities may lead to solid bony ingrowth of the graft. In spite of the relatively small volume of the screws and the technical simplicity of correct screw insertion, the mechanical stiffness of the instrumented spine is 2.4 times that of the uninstrumented spine. In static loading tests [17, 25] and in cyclic loading tests stiffness was maintained for 5000 cycles [17] with this technique.

According to the literature, the technical difficulties of pedicle screws are considerable and the complication rate significant. In selecting the appropriate internal fixation, the potential risks have to be weighed against the benefits to be expected. Incidence of clinically relevant nerve root injury from misplaced pedicle screws varies from 0 to 12% [21] in earlier reports, but remains around 3% [9] in more recent studies. In terms of complications involving injury of neurological structures, the translaminar screw technique compares favorably with these reports of pedicular fixation. Only four patients (2.5%) out of the 145 showed postoperative neurological deficits that were not present preoperatively. Only one of these had motor weakness, and three complained of sensory disturbances. All neurological signs resolved 3–6 months postoperatively, and were not present at follow-up. Three of these patients underwent simultaneous decompressive procedures. We attribute the low incidence of neurological injuries with translaminar screw fixation to the fact that insertion of the screws is technically easy and the learning curve, therefore, is short [13, 17, 22a].

Placement is performed open under quasi-direct visual control of the drill and the screw. Penetration of the spinal canal is safely avoided by using a dissector underneath the lamina during the drilling procedure.

The 5.5% rate of pseudarthrosis in our previously published series of translaminar screw fixations [13] and the 6% rate in the present study compares favorably with pedicular systems (5–23%) [4, 42]. However, these patient groups are difficult to compare because of different indications, different degrees of instability, and various lengths of fusions. Jacobs reported with the same technique a rate of pseudarthrosis of 9% [22a]; however, Heggeness and Esses [17] were able to reduce non-union in a series of 18 cases down to one patient (5.5%) with the only modification of decorticating the joint surfaces. Reich et al. [34] had a 1.6% pseudarthrosis rate, reporting that fusion took place 5 months after surgery.

The standard technique for translaminar screw fixation uses stainless steel screws; however, by using titanium screws, modern diagnostics with MRI and CT can be performed without any major signal alteration.

Metal removal is seldom indicated due to the small volume of the implant, and was indicated in only five patients in our series. If necessary, it can be performed percutaneously under C-arm guidance.

The screws rely on bony purchase of posterior elements of the vertebrae (lamina, facets, transverse process). Several contra-indications for this technique derive from this fact. The posterior elements have to be substantial enough to match the dimensions of the screw. Severe osteopenia may jeopardize the screw purchase. Screw loosening and pseudarthrosis are more likely to occur in these cases. Since the locked facets eliminate rotation in the y and z axes, but are less effective in the x axis, an intact anterior column is mandatory for this technique. A normal disc is no contra-indication, since the axial load may effectively be neutralized by the disc, as indirectly shown in the low pseudarthrosis rate of our series. The translaminar screws provide segmental fixation. Polysegmental fixation creates longer lever arms without multiplication of the anchoring points within the whole fixation, due to absence of intersegmental connections. No statistical difference in solid bony union was found between mono- and bisegmental fixations in our series; the number of three segmental fixations was too small for meaningful comparisons. However, for mechanical reasons, we do not advocate fixation of more than two adjacent segments. For the same reason, translaminar screws should not be used to extend an existing fusion.

Isthmic spondylolysis should not be an indication for translaminar screw fixation, for anatomical reasons. Degenerative and dysplastic spondylolisthesis have an altered but intact joint and interarticular portion, respectively. Translaminar screw fixation may, therefore, be considered in these cases, provided careful intertransverse decortication and grafting is performed.

In summary, we consider internal fixation with translaminar screws to be an economic, safe and efficient procedure to enhance solid mono- or bisegmental fusion with autologous bone graft of the lumbar and lumbosacral spine. This technique is indicated in conditions with a mechanically intact anterior column, and where the posterior elements – lamina and facets – are able to receive a 4.5-mm screw.

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