Posterior lumbar interbody fusion

A retrospective study of complications after facet joint excision and pedicle screw fixation in 148 cases

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We retrospectively evaluated neurological and other complications related to posterior lumbar interbody fusion (PLIF) performed by facet joint excision and pedicle screw fixation, in 148 consecutive patients with degenerative disorders. Their mean age at surgery was 59 (19–80) years. The mean follow-up period was 3 (2–6.5) years. Overall, 91 complications in 75 cases were observed. Although no permanent neural damage was detected, transient neural palsy occurred in 8% of the cases. Dural tear, partial misplacement, loosening, breakage of the pedicle screw and loss of correction were seen in 6, 6, 4, 1 and 1 of the cases, respectively. Deep infection of the fused segment developed in 2 cases. We conclude that PLIF, performed by facet joint excision and pedicle screw fixation, demonstrated a very low incidence of osteosynthesis failure, such as screw loosening, breakage and loss of correction. However, the high incidence of other complications, particularly neurological impairment, is still a disadvantage of this technically-demanding procedure.

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Posterior lumbar interbody fusion (PLIF) was proposed as one of the procedures to obtain solid mechanical efficacy (Capener1932, Cloward 1953). Steffee and Sitkowski (1988) stated that PLIF in conjunction with pedicle screw fixation was mechanically ideal and enhanced the osteosynthesis and success rate of the spinal fusion. There is a risk of neurological complications when performing PLIF mainly because the spinal canal is not wide enough to permit safe passage of PLIF materials into the interbody space (Fraser 1995). Entire excision of the bilateral facet joints, including the inferior portion of the superior lamina, increases the space available for the PLIF maneuver, and could decrease the neurological complications. Segmental instability induced by entire excision of the facet joints could also be overcome by the mechanical strength of pedicle screw fixation. Therefore, in our institute, PLIF for degenerative disorders has been performed by entirely excising the bilateral facets and pedicle screw fixation since 1992. We have retrospectively analyzed complications, especially neurological impairment, of this procedure.

Patients and methods

Between 1992 and 1995, we treated 148 consecutive patients (80 women) with PLIF performed by excision of the facet joints and pedicle screw fixation. Their mean age at the time of surgery was 59 (19–80) years. The mean follow-up period was 3.2 (2–6.5) years. Disorders treated by this procedure included degenerative spondylolisthesis (79), isthmic spondylolysis and spondylolisthesis (56), degenerative lumbar scoliosis (6), failed back syndrome (4) and others (3). Single-level fusion was done at L4/5 in 81 cases and at L5/S1 in 38 cases. Two-level and three-level fusions were also done in 12 and 3 cases, respectively (Table 1).

In our institute, complete excision of the bilateral facet joints, including the inferior portion of the superior lamina in the affected segment, has routinely been carried out. This surgical step enabled us to increase the space available for the PLIF maneuver. Therefore, safe curettage of the disc and passage of PLIF materials into the interbody space, and accurate probing and screwing with palpation of the medial and inferomedial wall of

Table 1. Fusion levels

Level of fusion	DGS	ISO	Degen. scoliosis	Failed back	Others	Total
L2/3			1		1	2
L3/4	9	1	1		1	12
L4/5	59	17		4	1	81
L5/S1	1	37				38
L2/3/4	1					1
L3/4/5	9	1	1			11
L2/3/4/5			3			3
Total	79	56	6	4	3	148

DGS Degenerative spondylolisthesis.
ISO Isthmic spondylosis/-olisthesis.

the pedicle could be done. Standard anatomical landmarks were used for the entry point of pedicle probing and screwing (Weinstein et al. 1988). The implants used were an Akita Pedicle Screw System (Mizuhoika Corp. Tokyo) in 137 cases (Abe et al. 1991, Okuyama et al. 1993a, b, 1995), Variable Spinal Plate in 6, and Cotrel-Dubousset instrumentation in 5. A screw with a diameter of 7 mm and a length of 40 mm was usually used. The apatite and wollastenite containing glass ceramic spacer (AW-GC) was also applied for PLIF with autologous bone graft from the right iliac crest in 117 cases (Yamamuro et al. 1990, Shimizu et al. 1992). The average operation time was 4.6 (SD 1.5) hours. The average blood loss during surgery was 0.6 (SD 0.4) L. Auto-transfusion or cell-saver system was used in 118 cases. Antibiotic prophylaxis was routinely administered during the day of the operation and a week postoperatively. Ambulation was permitted 2–3 days after operation. Soft braces were routinely worn for 6 months. Semi-hard braces were also applied for the first 3 months after operation in osteoporotic cases. Isometric muscle exercises were introduced 3-4 weeks after surgery.

Anteroposterior and lateral plain radiograms were taken immediately after surgery. CT scanning was also performed if there was any doubt that the screw was placed out of the pedicle on the plain radiograms or a neural deficit was observed immediately after operation. Screw misplacement was defined when it was confirmed that the screw had been placed totally or partially out of the pedicle on the plain radiograms or CT scan. In all cases, clinical and radiographic assessments were done at 6 weeks, 3 months, 6 months, 1 year and at the final follow-up. Correction loss was defined as an increased kyphosis greater than 3 degrees or slippage of more than 2 mm. If a continuous radiolucent zone at the bone-screw interface of 1 mm or more was observed, it was said that the screw had loosened.

Results

We observed 91 complications in 75 cases

Intraoperative complications (50 cases). Transient nerve root palsy was observed immediately after the operation in 12 cases. The palsies spontaneously recovered within 3 months after surgery. Dural damage was observed in 6 cases. Partial screw misplacement was found in 6 cases. Pedicle fracture developed in 3 cases during a reduction maneuver at surgery. No neural deficit was observed as a result of dural damage, screw misplacement or pedicle fracture. Coupling failure due to inadequate nut tightening was observed in 2 cases. A screw backed out when a rotatory reduction was attempted in 1 case of degenerative lumbar scoliosis. Partial migration of an AW-GC spacer into the subchondral bone was observed on radiograms immediately after the operation in 9 cases, but none of them migrated anymore. Temporal palsy of the lateral cutaneous nerve of the thigh during surgery was observed in 11 cases (Table 2).

Postoperative complications (26 cases). Screw loosening was observed in 4 cases. Screw breakage developed in 1 case (Figure 1). There was a

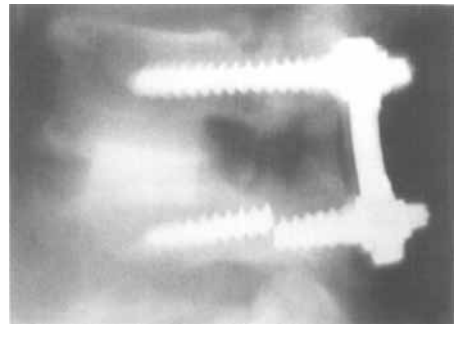

Figure 1. Lateral tomogram 2 years after operation in a 69-year-old man with degenerative spondylolisthesis in L4/5 showing screw breakage.

Table 2. Intraoperative complications of PLIF performed by facet excision and pedicle screw fixation for degenerative disorders

	DGS n 79	ISO n 56	Degen. scoliosis n 6	Failed back n 4	Others n 3	Total n 148
Transient nerve root palsy	6	5	1			12
Dural damage	1	5				6
Screw misplacement	5	1				6
Pedicle fracture	1	1	1			3
Coupling failure	1	1				2
Back out of screw			1			1
AW-GC migration [a]	6	2	1			9
Meralgia paresthetica [b]	5	4	1		1	11
Total	25	19	5		1	50

DGS Degenerative spondylolisthesis.
ISO Isthmic spondylosis/-olisthesis.
[a] AW-GC apatite and wollastenite containing glass ceramic spacer.
[b] Meralgia paresthetica palsy of the lateral cutaneous nerve of the thigh.

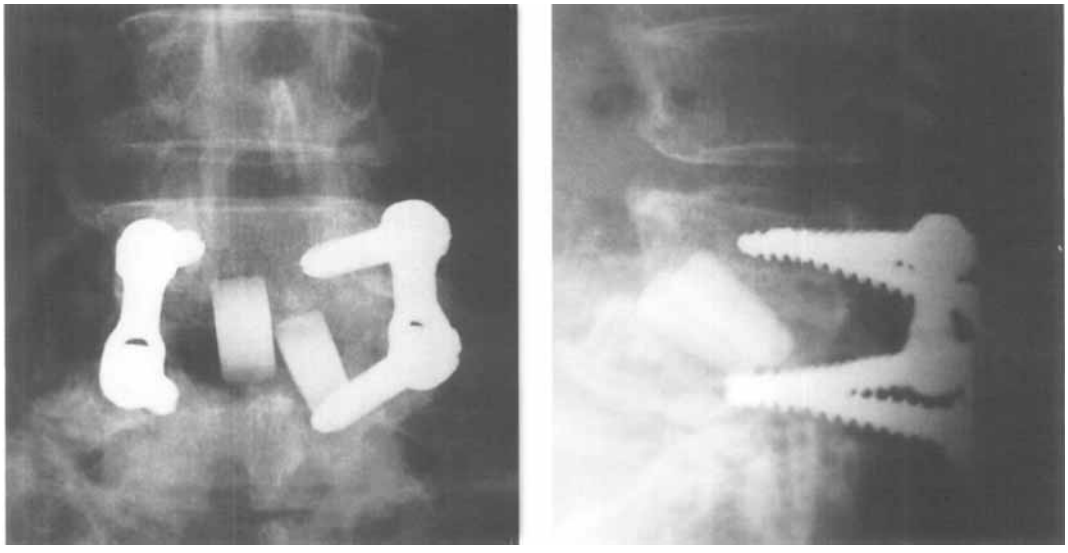

Figure 2. A 72-year-old man with failed back syndrome in L4/5 and deep infection. The infection was healed by intensive chemotherapy, but AW-GCs migration into the vertebral bodies was remarkable.

case with loss of correction at final follow-up. 1 case developed L5 radiculopathy caused by an AW-GC spacer protrusion into the spinal canal 3 months after the operation. The protrused spacer was partially resected by air-drill after bone fusion was completed. Breakage of an AW-GC spacer also developed in 1 case, with no symptoms. Superficial wound infections were observed in 3 cases, and deep infection of the fused segment developed in 2 cases. Discitis of an adjacent intervertebral disc to the fused segment occurred in 2 cases. Curettage and arthrodesis of the infected disc with removal of the implant was performed in 1 case of discitis. Other infected cases were treated by intensive chemotherapy, without implant removal (Figure 2). Insufficient wound healing was found in 5 cases. In 4 osteoporotic cases, compression fracture in an upper vertebra adjacent to the fused

Table 3. Postoperative complications of PLIF by facet excision and pedicle screw fixation for degenerative disorders

	DGS n 79	ISO n 56	Degen. scoliosis n 6	Failed back n 4	Others n 3	Total n 148
Screw loosening	3	1				4
Screw breakage	1					1
Correction loss	1					1
AW-GC protrusion [a]	1					1
AW-GC breakage [a]	1					1
Superficial infection	2		1			3
Deep infection	1			1		2
Discitis of adjacent disc	1	1				2
Insufficient wound healing	2	3				5
Compression fracture of adjacent vertebra	2		2			4
Herniation of adjacent disc	1	1				2
Total	16	6	3	1		26

DGS Degenerative spondylolisthesis.
ISO Isthmic spondylosis/-olisthesis.
[a] AW-GC apatite and wollastenite containing glass ceramic spacer.

segment was observed (Figure 3). Disc herniation of a disc space adjacent to the fused segment was also observed in 2 cases (Table 3).

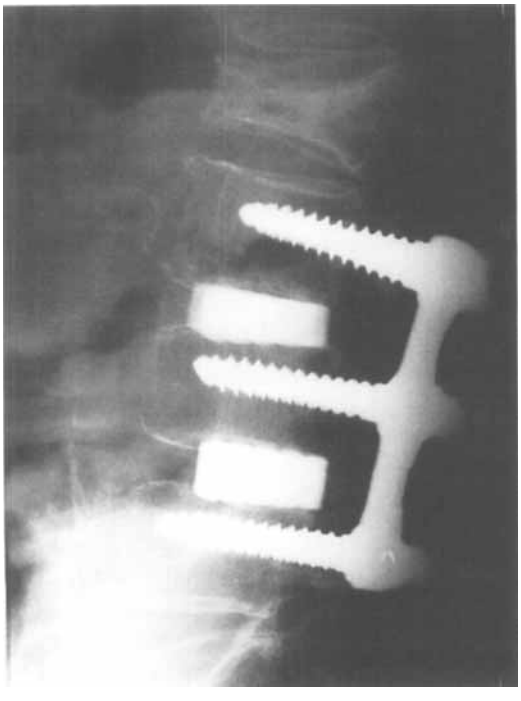

Figure 3. 2 years after operation in a 73-year-old woman with degenerative spondylolisthesis in L3/4/5 with a compression fracture in the L2 vertebra.

Liver dysfunction was observed in 5 cases. Colitis induced by the antibiotics was found in 3 cases. Pulmonary embolism developed in 2 patients in whom cardiac and respiratory failure suddenly occurred 4–5 days after the operation. Both patients survived. Pressure sore of the face developed during operation in 3 cases. Pneumonia and depression developed in 1 case.

Discussion

The high incidence of 91 complications in 75 cases may be partially attributed to our liberal definitions of complications.

The risk of neurological complications while performing PLIF has not been removed. Fraser (1995) reviewed one series reporting that 4 of 21 cases, in which PLIF was performed without removal of a large portion of the facet joint, developed neurological complications, and 3 cases did not recover. If entire excision of the bilateral facet joints is carried out, the space available for the PLIF maneuver substantially increases, and safe curettage of the affected intervertebral space and passage of corticocancellous bones or cage materials become possible. Using this technique, we found no permanent nerve damage.

Retraction of the dural tube and the nerve roots cannot be avoided even after removal of the entire facet joints. By measuring the root action potential in vivo, Dezawa et al. (1997) demonstrated that the tension of nerve-root retraction by the PLIF maneuver was 1.5–3 times higher than in the usual Love's operation. In our study, transient nerve palsy, supposed to be caused by retraction of the neural tissue, still occurred in 8% of the cases. Probably more careful handling of the dural tube and the nerve roots could reduce the neurological complications. West et al. (1991) proposed that misplacement of pedicle screws in the medial or inferomedial direction of the pedicle wall was hazardous to the nerve roots. The entire excision of the bilateral facet joints makes palpation of the medial and inferomedial wall of the pedicle possible for prevention of nerve-root damage by screws. No nerve-root injury related to probing and screwing occurred in our patients.

Screw loosening and breakage have been reported in 2–27% and 0–15%, respectively (Marchesi et al. 1991, Esses et al. 1993, Soini et al. 1993, Zdeblick 1993, Pihlajamäki et al. 1997). Both complications are closely related to loss of correction and pseudoarthrosis. To avoid these complications, anterior bone grafting at the time of posterior osteosynthesis has been proposed (Gurr et al. 1988, West et al. 1991, Maiman et al. 1993). In our study, screw loosening, breakage and loss of correction, excluding the infection cases, was less than 3%. This is satisfactory and may suggest a mechanical superiority of PLIF with pedicle screw fixation.

The most serious complication was pulmonary embolism, although our 2 patients survived. West et al. (1991) reported 1 case of a fatal pulmonary embolism in 124 consecutive cases of pedicle screw fixation. Ohlin et al. (1994) recorded 3 cases of pulmonary embolism in 163 cases with pedicle screw fixation.

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