

Posterior spinal fusion using internal fixation with the Daab plate

The results of posterior spinal fusion, supplemented by internal fixation with the Daab plate in 43 patients, are presented. The Daab plate is a quadruped implant placed longitudinally in the coronal plane and fixed by simply pinching it around the spinous processes. The cause of the instability necessitating fusion was acute trauma in eight patients, late posttraumatic condition in 11, pure degenerative process in seven and spondylolisthesis in nine patients. In addition, there were solitary cases of tuberculous spondylitis, pyogenic spondylitis and metastatic destruction of the vertebral body. The fusion site was cervical in three, thoracic in eight, thoracolumbar in 12 and lumbar or lumbosacral in 20 cases.

The mean follow-up time was 19 months. The consolidation of the fused area could, apart from radiographs, ultimately be evaluated at removal of the implant in 39 patients. The fusion was successful in 37 patients. Compared with previous reports, this result must be considered satisfactory when the severity of the cases in this series is noted. Internal fixation in connection with posterior fusion is needed only exceptionally, but in complicated cases the Daab plate seems to afford a simple method of securing the position of the segments for the first postoperative months.

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Osseous union will not take place if there is continuous excessive motion of the adjacent bone fragments. This is a principle that is valid for the spinal column, too. The over-all rate of solid union after surgical fusion of spinal units for a degenerative process has been estimated at 85 per cent (Hoover 1968). Successful fusion is even less common when two or more intervertebral levels are involved and in patients with spondylolisthetic instability, severe trauma, progressive deforming disease or previous surgical procedure.

Several methods of spinal fusion using internal fixation by metallic implants to fix the segments and maintain immobilization have been described, among which are the following: short screws through the facet joints (King 1948), long screws passing through the pedicles into the vertebral body (Boucher 1959) and posteriorly placed springs with hooks (Attenborough & Reynolds 1975). Furthermore, even

Harrington and Knodt rods have been used in the treatment of conditions like spondylolisthesis (Thomas 1981).

Except for Harrington instrumentation in scoliosis and unstable vertebral fractures, none of the methods of internal fixation seems to have won universal approval in surgery of the spine. This paper reports our 4-year experience of posterior fusion using supplementary internal fixation with the Daab plate, a method hitherto unfamiliar to the literature in English.

Patients and methods

This series consisted of 43 consecutive patients in whom the Daab plate was used for internal fixation in connection with a posterior fusion operation at the Department of Orthopaedics and Traumatology, Helsinki University Central Hospital, between 1979 and 1982.

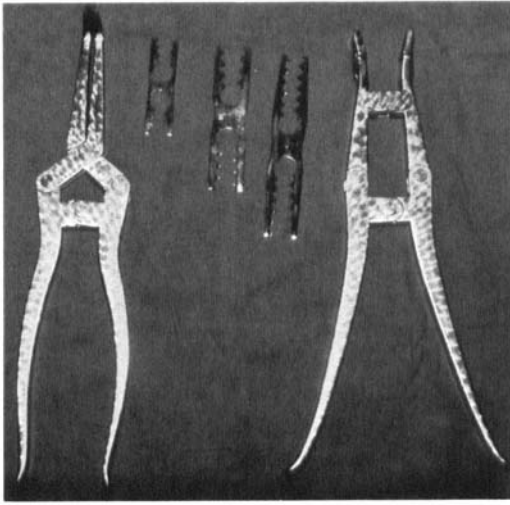


Figure 1. The Daab instrumentation: the three available standard sizes of the implant and the special pliers, one for fixation and the other for removal of the plate.

The Daab plate was originally developed in the 1960's for stabilization of acute unstable vertebral fractures by Janusz Daab of Piekary, Poland (Daab 1971). The plate is a one-piece implant made of low carbon vacuum melted stainless steel. It is available in three sizes: 60, 80 or 120 mm in length (Figure 1). The appropriate size is chosen, depending on the region of the spine to be operated upon and the number of intervertebral spaces to be fused. The plate is placed posteriorly longitudinally in the coronal plane after resecting one spinous process, if necessary (Figure 2). The "extremities" of the quadruped implant are simply pinched around the bases of the adjacent spinous processes. The only special instruments required are pliers with a blocking system to prevent the spinous processes from being crushed. The actual fusion was accomplished with iliac cortico-cancellous chip grafts laid in the well-established way on the denuded laminae and articular processes lateral to the plate.

The mean age of the patients was 44 (15–74) years. There were 22 men and 21 women. In 19 patients the indication for the fusion operation was a traumatic condition (Figures 2 and 3), in nine cases it was spondylolisthesis and in seven degenerative vertebral instability (Table 1). In cases of acute trauma the Daab plate was used only once in the thoracolumbar junction, a site suited better to other methods of fixation. In the whole material the clinical picture was dominated by local pain in the back in 16 patients. In 12 patients there was pain radiating to the lower extremity. In the remaining 15 cases the mechanical instability necessitated surgical sta-

bilization to protect neural structures from further damage and to prevent or correct residual deformity of the spine. Paraparesis or paraplegia was present in nine patients. Previous operations on the spine had been carried out in 26 patients, the total number of the procedures being 44. These included laminectomy in 11 and previous unsuccessful attempts to achieve posterior fusion in another nine patients.

Except for the patients who had acute unstable vertebral fracture, getting out of bed was allowed postoperatively on the following day. The patients with acute trauma were confined to bed for 4–6 weeks, depending on the site and initial instability of the injury. Routine cervical or lumbosacral support was used only for patients operated on because of acute trauma, for whom it was used for 3 months.

The implant was removed after 1 year on average. The mean follow-up time was 19 (11–37) months. Within the follow-up time, the implant was removed and consequently the consolidation of the fusion could be evaluated on this occasion in 39 patients.

Results

The number of intervertebral spaces fused using internal fixation with the Daab plate was as follows: one intervertebral space in seven patients, two spaces in 25, three spaces in nine and four spaces in two patients. These operations were not all simple posterior fusions; other procedures on the spine were done simultaneously in 22 patients (Table 2).

The immediate postoperative complications included two superficial wound infections. Deep infections did not occur. Deep venous

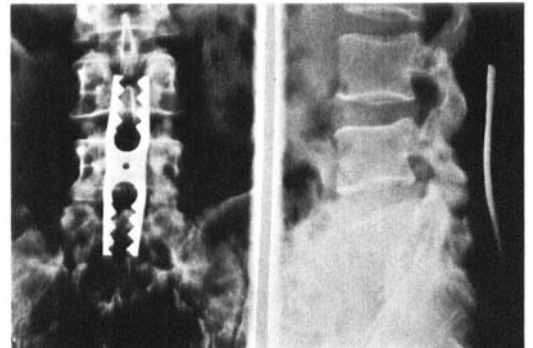


Figure 2. Anteroposterior and lateral radiographs of acute traumatic subluxation of the fifth lumbar vertebra after reduction and posterior fusion with internal fixation; the Daab plate secured two-level fusion.

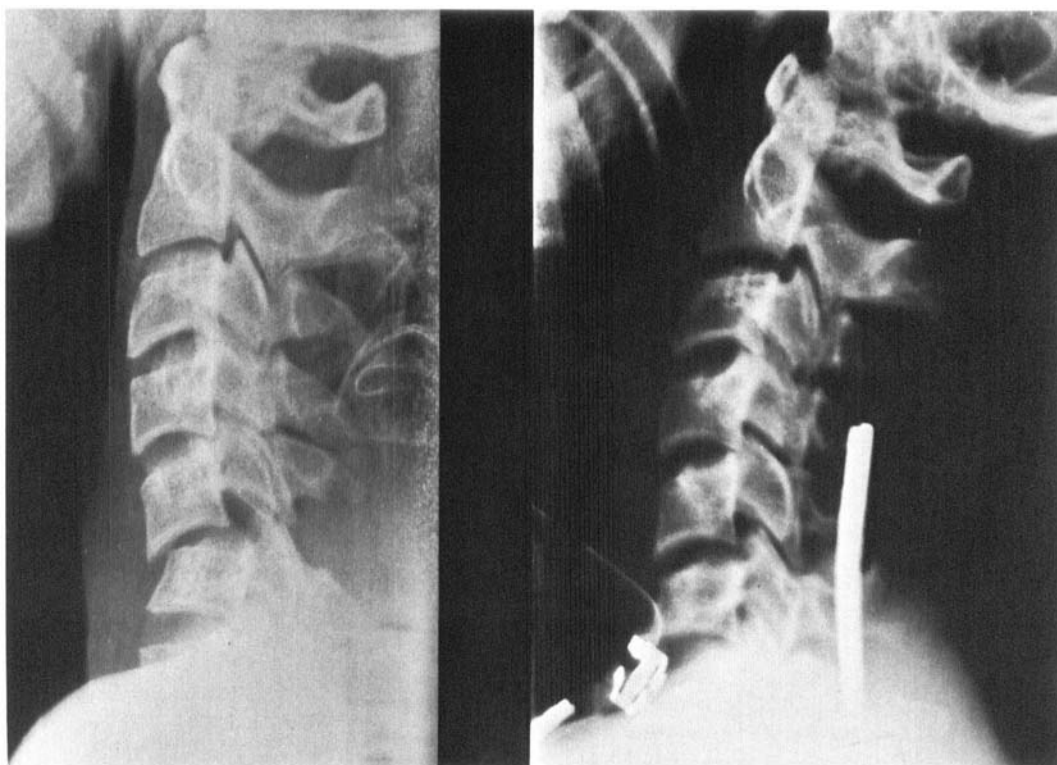


Figure 3. Lateral view of acute dislocation at the level between the fifth and sixth cervical vertebrae. Open reduction turned out to be necessary, and internal fixation with the Daab plate was done in connection with a posterior fusion procedure to maintain the position without using skull traction.

thrombosis was diagnosed in two patients, both with complete post-traumatic paraplegia.

Successful consolidation of the fused area was achieved in 37 patients (86 per cent). There were six failures. In three cases the plate loosened within the first 4 months and

necessitated reoperation. In another three patients the desired position of the fused segments was maintained but the consolidation was deemed doubtful on routine radiographs. In two of these three patients, unsuccessful consolidation was indeed found when the im-

Table 1. Cause of spinal instability necessitating fusion

Diagnosis	Level (no. of patients)				Total
	Cervical	Thoracic (D I–XI)	Thora-columbar junction	Lumbar or lumbosacral (L II–S I)	
Tuberculous spondylitis	–	4	1	–	5
Pyogenic spondylitis	–	1	–	–	1
Metastatic destruction of vertebral body	–	1	1	–	2
Acute unstable fracture-dislocation (within 2 weeks of the accident)	3	2	1	2	8
Post-traumatic instability	–	–	9	2	11
Spondylolisthesis	–	–	–	9	9
Degenerative instability	–	–	–	7	7
Total	3	8	12	20	43

Table 2. Extension of procedures with the Daab plate as a method of fixation of the spine

Procedure	No. of patients
Posterior fusion only	21
Simultaneous	
Anterior interbody fusion	2
Anterolateral decompression	3
Removal of disc prolapse	4
Laminectomy	5
Reduction of fracture-dislocation	8
Total	43

plant was removed 1 year after the fusion operation. The third patient is asymptomatic with the plate still *in situ*. The failures were multiple-level procedures for post-traumatic conditions except for one operation done for spondylolisthesis.

Subjective relief at follow-up was recorded in 19 (68 per cent) of the 28 patients operated on for an instability that presented clinically as local back pain or radiating pain to the lower extremity.

The mean duration of hospitalization after the fusion operation, patients with acute trauma and/or paraplegia excluded, was 11 days. For patients with acute vertebral fractures the duration was 54 days.

Discussion

The criteria for evaluation of the result of spinal fusion operations should be both biomechanical and social. However, for verification of the consolidation of the fusion routine or even stress radiographs are not absolutely reliable and the only certain method is reexploration of the fused area (Hoover 1968). Indeed, in this study this could be conveniently accomplished when the implant was removed. But a solid fusion seems to be neither a prerequisite nor a guarantee for a good functional result and social recovery. This especially applies to cases with "degenerative" lumbar or lumbosacral instability and has resulted in a reformed, more selective attitude to spinal fusion for these patients (Farfan & Kirkaldy-Willis 1981).

The present series, however, was concerned with a more heterogeneous patient material, many of whom had an absolute indication for fusion. Taking into account the many previous operations and the number of multiple-level fusions, the rate of biomechanical success must be considered acceptable. The results, as for subjective pain relief, were close to the values reported previously in the few studies where this point of view, too, has been recorded (Tunturi et al. 1979, Kiviluoto et al. 1980).

A rigid internal fixation of the spinal column does not remain rigid for long (Attenborough & Reynolds 1975). The constructor of the Daab plate thinks that the rigidity of the fixation is maintained for 2–3 months, a time long enough to allow initiation of osseous union between the fragments. The implantation of the Daab plate requires in most cases resection of one spinous process with its inter- and supraspinous ligaments. But experimental evidence exists for the relative unimportance of these ligamentous structures for the stability of at least the thoracic spine (Panjabi et al. 1981).

Considering acute unstable vertebral fractures in the thoracolumbar junction the Daab plate should not be regarded as an alternative to Harrington instrumentation. But fracture-dislocations in the cervicothoracic and lumbosacral junctions may, in turn, be better suited to fixation just with the Daab plate.

In conclusion, a supplementary internal fixation in connection with posterior spinal fusion is certainly needed only exceptionally. The Daab plate is a technically simple method of fixation and its use could be worthwhile, e.g. when posterior fusion is indicated after previous laminectomy or failed fusion, in patients with acute fracture-dislocation in the lower cervical, upper thoracic or lower lumbar regions and in combination with anterolateral procedures requiring simultaneous posterior fusion.

References

- Attenborough, C. G. & Reynolds, M. T. (1975) Lumbo-sacral fusion with spring fixation. *J. Bone Joint Surg.* **57-B**, 283–288.

- Boucher, H. H. (1959) A method of spinal fusion. *J. Bone Joint Surg.* **41-B**, 248–259.
- Daab, J. (1971) Stabilization of the vertebral column by means of a metal plate constructed by the author supplemented with bone graft. Diary of the XVIII Scientific Meeting of the PTO Tr, pp. 665. PZWL, Warszawa.
- Farfan, H. F. & Kirkaldy-Willis, W. H. (1981) The present status of spinal fusion in the treatment of lumbar intervertebral joint disorders. *Clin. Orthop.* **158**, 198–214.
- Hoover, N. W. (1968) Methods of lumbar fusion. *J. Bone Joint Surg.* **50-A**, 194–210.
- King, D. (1948) Internal fixation for lumbosacral fusion. *J. Bone Joint Surg.* **30-A**, 560–565.
- Kiviluoto, O., Salenius, P., Pylkkänen, P. & Morri, P. (1980) Posterolateral spine fusion. An analysis of 80 consecutive cases. Proceedings of the Finnish Orthopaedic Association. *Acta Orthop. Scand.* **51**, 365.
- Panjabi, M. M., Hausfeld, J. N. & White, A. A. III (1981) A biomechanical study of the ligamentous stability of the thoracic spine in man. *Acta Orthop. Scand.* **51**, 315–326.
- Thomas, W. (1981) Zur Problematik dorsaler Spondylodesen unter Verwendung von Distractionsstäben. *Zeitschr. Orthop.* **119**, 535–539.
- Tunturi, T., Kataja, M., Keski-Nisula, L., Lapinsuo, M., Lepistö, P., Paakkala, T., Pätäälä, H. & Rokkanen, P. (1979) Posterior fusion of the lumbosacral spine. Evaluation of the operative results and the factors influencing them. *Acta Orthop. Scand.* **50**, 415–425.