Dwyer–Hartshill Transpedicular Fixation for Spinal Fusion

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We report the technique and early results of the Dwyer–Hartshill method for segmental fixation of the spine. This uses pedicular screws wired to a rectangular frame and is indicated after laminectomy.

The technique of segmental fixation which we describe is used in patients who have had a laminectomy and who subsequently need spinal fusion. It combines features of two existing systems of internal fixation. Stainless steel Dwyer screws, normally used in the vertebral bodies at operations for scoliosis, are inserted through the pedicles and wired to a rectangular frame. This is then secured by sublaminar wires at levels where the laminae remain intact.

**OPERATION**

The site and extent of the proposed fusion is determined pre-operatively, using discography to identify the first normal intervertebral disc above the previous surgical field. Fusion should extend from the transverse processes of the vertebra below this disc to the alae of the sacrum; the rectangle is secured to the sacrum, to the laminae of the vertebra immediately below the normal disc and to the transpedicular screws.

The patient is placed prone on a frame with the abdomen free of pressure. The previous longitudinal scar is extended to reach normal tissues, making it easier to locate the laminectomy defect when the paravertebral tissues are stripped laterally. Any remaining spinous processes are useful landmarks in the dissection. A strip of the scarred erector spinae muscle mass is then excised using a diathermy needle. This helps access to the transverse processes which are cleaned as far as their tips. The laminectomy membrane is then carefully dissected off the dura to allow clearer identification of the bony landmarks.

The precise point of entry for the Dwyer screw is important, (Roy-Camille, Saillant and Mazel 1986). This point is at the intersection of two lines (Fig. 1). The first line is one joining the transverse processes and the second is a caudal projection of the upper facet joint onto the...

Fig. 1

Fig. 2

Photographs of a fourth lumbar vertebra with transpedicular Dwyer screws in situ. The point of entry is at the level of the transverse processes and at the caudal limit of the upper facet joint.
crest of the pars interarticularis. This crest and the transverse line cross just below and lateral to the facet joint. The exact point of drill entry is best identified by a partial excision of the lower pole of the facet joint which should include any prominent osteophytes.

The craniocaudal direction of the drill varies with each lumbar vertebra because of the lumbar lordosis, but the pedicles also run in a variable anteromedial direction (Fig. 2). Roy-Camille et al (1986) have defined this angle at various lumbar levels from cadaver studies, the pedicle of L5 being up to 30° from the sagittal plane. The pedicle is then drilled, using a 3.2 mm bit. We use a hand drill for safety; it is less likely to breach the walls of the pedicle as it passes into the vertebral body, but the length and position of the drill bits are checked radiographically. The drill should pass down the middle of each pedicle.

The screws are then inserted, also under radiographic control (Figs 3 and 4) and attached by 20-gauge stainless steel wire loops through the screw heads to a Hartshill rectangle. This in turn is secured by sublaminar wiring to the sacrum caudally and to the laminae of the uppermost vertebra. The stability of the superior spinal segment is important so these sublaminar wires are passed from below and received through bilateral ligamentum flavum fenestrations. The interspinous ligament and the facet joints are preserved at this level. When extensive portions of the proximal sacrum have been removed at previous operations, it may not be possible to secure the lower part of the Hartshill rectangle by sublaminar wiring. In such a case Dwyer screws are inserted into the alae of the sacrum and secured to the rectangle by wire.

Abundant cancellous and corticocancellous bone grafts are laid along the paravertebral gutters and the

Radiographs of the lumbar vertebra shown in Figures 1 and 2.

Figure 5 - Lateral view after Dwyer-Hartshill fixation and grafting for multilevel post-laminectomy instability. Figure 6 - Postero-anterior view eight months after fixation and grafting for symptomatic lytic spondylolisthesis at L5/S1, showing consolidating fusion masses. Figure 7 - Postero-anterior view 12 months after fixation and grafting from L3 to S1 following an extensive decompression for degenerative spinal stenosis.
wound closed. After operation, patients are up after six to seven days, but a polypropylene lumbar support is worn for a minimum of 12 weeks.

PATIENTS

We have used the Dwyer–Hartshill instrumentation and fusion for 33 patients; 16 had previously had laminectomies (Fig. 5), including six who had had two previous laminectomies and one who had had four previous operations. Ten patients with spondylolysis were treated by excision of the free neural arch before fusion (Fig. 6), and seven patients with spinal stenosis producing spinal claudication and mechanical back pain had laminectomy, decompression and Dwyer–Hartshill fusion (Fig. 7).

RESULTS

There have been no deaths. One patient developed a persistent sinus which healed after debridement, irrigation and antibiotics, with no further recurrence. One patient developed an iliofemoral venous thrombosis. One patient broke the most cranial wires; this may have been because a 4-level laminectomy had placed great stress on the proximal end of the fixation. We now use transpedicular Dwyer screws at the most proximal level to be instrumented. One patient had a transient unilateral loss of perineal sensation.

Fourteen patients have been assessed after one year and all have solid fusions. One patient with spondylolisthesis had required a revision operation for pseudarthrosis.

DISCUSSION

Transpedicular screw fixation is not a new technique, but our method differs from that used by others (Luque 1986; Roy-Camille et al 1986) in that the transpedicular screws are secured to the closed loop of the Hartshill rectangle, thereby controlling rotation of the fusing segments. Dwyer screws have a large core diameter and grip not only the vertebral body but also have some purchase on the walls of the pedicles. We believe that smaller screws would be prone to breakage or loosening.

The axes of the pedicles of the lumbar vertebrae run in well-described patterns but we have found that these axes vary not only from vertebra to vertebra but also from patient to patient, and indeed, from side to side in an individual vertebra. The variable lumbar lordosis adds another difficulty. The use of jigs to help the placement of screws is not practicable in the post-laminectomy patient, because of the distorted anatomy, and the pedicles do not lie in a straight line, making the use of plates very difficult. Rods which have to fit into slots in the heads of other transpedicular screws are also difficult to contour. With the system we describe, there are no such problems since the rectangle can be secured to the transpedicular screws with varying lengths of wire. Large plates or separate rods may obscure bone which should provide part of the bed for grafting, but the Hartshill rectangle (Dove 1986) is less bulky and does not obstruct access to the paravertebral fusion mass.

The Dwyer–Hartshill technique was first applied in the difficult post-laminectomy patient, but is now used in the treatment of spondylolisthesis and spinal stenosis. In patients with grade I or II spondylolisthesis, after removal of the loose neural arch, and in spinal stenosis after widespread laminectomy, it is easy to insert the fixation through unscarred tissues. Although our experience with this technique is still limited we feel that it is a sound method of promoting an intervertebral fusion. Transpedicular fixation is not simple, but our method is relatively easy to apply and is far less expensive than other systems.

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REFERENCES

