CLOSING-WEDGE POSTERIOR OSTEOTOMY FOR ANKYLOSING SPONDYLITIS

PARTIAL CORPORECTOMY AND TRANSPEDICULAR FIXATION IN 22 CASES

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From 1990 to 1993 we treated 22 consecutive patients who had progressive spinal kyphosis due to ankylosing spondylitis by a closing-wedge posterior vertebral osteotomy with partial corporectomy of L4 and transpedicular fixation.

The average correction was 32° (24 to 52) with a mean loss of correction after operation of 2.7° (0 to 13). The average operating time was 185 minutes (135 to 240) and blood loss was 2500 ml (1200 to 5000). The osteotomy corrected all patients sufficiently to allow them to see ahead and their posture was improved.

There were no fatal complications, but in two cases there was failure of the instrumentation and one patient needed reoperation for nerve compression. Two deep wound infections required removal of the implant and six patients had superficial skin infections under the plaster. The use of a circioelectric bed and intermittent prone lying eliminated this problem.

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Several operative techniques have been used to correct the lumbar kyphosis in progressive ankylosing spondylitis. The aims of surgery are to restore the patients’ ability to see ahead to the horizon, to relieve compression of the abdominal viscera by the rib margin, and to improve the diaphragmatic respiration on which these patients often depend.

Smith-Peterson, Larson and Aufanc (1945) described two- and three-level osteotomies through the articular processes with resection of the spinous processes of L1, L2 and L3. Correction closed the wedge osteotomies of the posterior elements, then elongated the anterior column by disruption of the anterior longitudinal ligament. Many modifications of this procedure have been described (La Chapelle 1946; Briggs, Keats and Schlesinger 1947; Herbert 1959; Law 1969; Bossers 1972; Simmons 1977; McMaster 1985; Bradford et al 1987). This anterior opening-wedge osteotomy, producing a sharp lordotic angle and elongation of the anterior column, sometimes caused serious complications.

Weatherley, Jaffray and Terry (1988) showed that a 45° correction at the L2/L3 level increased the length of the anterior column by approximately 2 cm, with risks of neuropraxia and paraplegia due to compression, subdural and epidural bleeding. Retrograde ejaculation was mentioned (Styblo, Bossers and Slot 1985). Vascular calcification and reduced elasticity of vessel walls increased the risks of thrombosis of the mesenteric vessels leading to ileus, and of rupture of the aorta and its branches. Mortality was as high as 10% (Lichtblau and Wilson 1956; Herbert 1959; Law 1969; Klemes and Friedebold 1971; Styblo et al 1985; Camargo, Cordiero and Napoli 1986; Weatherley et al 1988).

In 1982 Püschel and Zielke introduced a method based on multiple osteotomies at four to six levels. At first, fixation was by Harrington rods, but later they used transpedicular screws for up to ten segments. This method gave more overall correction by the closing wedges of the dorsal osteotomies without fracturing the anterior column, and good results were reported in 177 patients by Hehne, Zielke and Bohm (1990). In our experience this multilevel technique was not successful, since in most cases the main correction was at one level.

Thomasen (1985) described a method of removing bone from the posterior part of the body of L2, then creating a wedge-shaped compression fracture of the body. Jaffray, Becker and Eisenstein (1992) reported three cases treated by closing-wedge posterior vertebral osteotomy with partial corporectomy of L4 and transpedicular fixation.

We considered that the combination of closing-wedge posterior vertebral osteotomy with partial corporectomy of L4 and transpedicular fixation could achieve a stable fixation and reduce the morbidity. We now report our technique and the results of our first 22 patients.

PATIENTS AND METHODS

We treated 22 patients with chronic ankylosing spondylitis by a closing-wedge lumbar osteotomy with partial corporectomy and transpedicular fixation. There were 18 men and 4 women, and their average age at the time of operation was 48 years (27 to 70). One patient was operated on in 1990, five in 1991, eight in 1992 and eight in 1993. Follow-
up was from 6 to 45 months (mean 22). All operations were performed by one of the authors (GS) using transpedicular screws and internal fixation with the H-frame (Waldemar Link GmbH & Co, Hamburg, Germany).

Before operation the thoracic kyphosis was measured on standing lateral radiographs of the whole spine and standardised over nine vertebrae. The mean thoracic kyphosis was 68° (45 to 90) with the apex in the high thoracic area. The full thoracic curves were much greater than the measured ones, because the upper thoracic discs were not always visible. In eight patients the hips were involved in the disease; four had had bilateral or unilateral total hip replacement before lumbar osteotomy. In the other 14 patients hip function was not affected. Twelve patients had preoperative respiratory function tests, and five of them showed some restrictive obstruction which did not, however, preclude operative intervention. Two patients had aortic stenosis; one of them required operation before the spinal correction.

**Operative technique.** The patient is placed prone on an inclined radiolucent table, with care not to injure the ankylosed neck. The chest and pelvis are supported on firm foam blocks which leave the abdomen hanging free to reduce intra-abdominal pressure. Most patients required intubation by fibre-optic laryngoscopy. Hypotensive anaesthesia and perioperative autotransfusion by means of a blood-cell separator (Cellsaaver III-plus; Haemonetics, Braintree, USA) were used in all cases to reduce the need for homologous blood.

The lumbar spine is exposed through a midline incision and the paraspinal muscles are stripped subperiosteally from the bone laterally to the tips of the transverse processes at the level of the osteotomy. Transpedicular screws are inserted through the centres of the pedicles of L3 and L5, approximately parallel to the upper end-plates, and converging towards the midline to penetrate the anterior cortex of the vertebral body. Screw location is controlled by image intensification.

A V-shaped wedge of bone and soft tissues, 5 to 7 cm at its base, and including spinous processes, laminae, articular processes and part of the floor and the roof of the intervertebral foramen, is resected (Fig. 1a).

When the cauda equina and both nerve roots of L4 are free, the pedicles are resected carefully, and, from both sides, a posterior wedge of the body and the base of the pedicle are excised. This results in profuse haemorrhage. The lateral walls are crushed and the transverse processes are partially excised (Fig. 1b).

The prebent H-frame rods are placed in position and the osteotomy is closed by slowly extending the table and elevating the patient’s legs. During this slow closure, the nerve roots and cauda equina are kept under continual observation. The anterior cortex of the vertebra acts as a hinge for the closure of the gap and there is no elongation of the anterior column and its related structures (Fig. 1c).

The fixation system is tightened in compression to obliterate the wedge and bone chips from the resected bone are applied as grafts. A well-moulded dorsal plaster shell is then applied.

The next day a ventral plaster shell is made and the dorsal shell is changed for a dry one. For the most recent five patients we used a circioclectric bed (Stryker, Uden, The Netherlands) postoperatively. Two weeks after operation the patients were allowed to mobilise in a plaster thoracolumbar spine orthosis (TLSO) with one hip included for four months. In 11 patients considered to be at risk of developing hip stiffness the plaster was changed at two months for one with a hip extension on the contralateral side.

**RESULTS**

The mean operating time was 185 minutes (135 to 240) and the mean blood loss was 2500 ml (1200 to 5000). In 16
patients the transpedicular fixation screws were placed at L3 and S1. in four at L3 and L5, in one at L4 and S1, and in one at L2 and S1. The osteotomies were at L4 in 21 patients and at L5 in one.

At latest follow-up, radiographs showed lumbar correction ranging from 24° to 52° (mean 32), with a mean loss of correction since operation of 2.7° (0 to 13) (Fig. 2). Loss of correction was seen only within the first three to four months, and solid anterior and posterior fusion was seen in every case by four months.

All patients were corrected enough to see straight ahead and their posture was improved (Fig. 3). Two patients showed an increase in kyphotic deformity at the cervicothoracic junction, and have been advised to have osteotomy at that level in the near future.

Complications. There were no fatal complications. Six patients had a dural tear during operation due to dural adhesion to the ossified ligamentum flavum. In each case, the dura was sutured and recovery was uneventful. In two cases there was failure at the junction of the pedicle screw and H-frame during follow-up; this was probably due to insufficient tightening of the nuts in patients with severe osteopenia. One patient needed spinal exploration for paresis and neuropraxia of the legs on the day after osteotomy. This was due to nerve compression caused by insufficient bone removal and there was full recovery after reoperation. Two deep wound infections made removal of the implant necessary in two patients after 4 and 12 months respectively, but both achieved sound fusion. Six early patients had superficial skin infections under the plaster, but this problem was not seen after we started to use a circloelectric bed and intermittent prone lying in a second plaster shell.

DISCUSSION

Ankylosing spondylitis may lead to a severe fixed kyphosis so extreme that the patient cannot stand, sit, or lie in comfort. Spinal osteotomy has helped many patients, but major complications have been reported. Closing-wedge osteotomy of only the posterior elements must cause elongation of the anterior column. We found that the multisegmental dorsal osteotomy of Zielke gave good results only in patients with discs that were not fully calcified, and most of our patients were in a later stage of the disease with fully calcified discs.
Posterior closing-wedge osteotomy has been proposed to reduce the morbidity (Thomasen 1985; Jaffray et al 1992; Thiranont and Netrawichien 1993), and internal fixation with wiring, metal plates or transpedicular fixation have been used. Thiranont and Netrawichien (1993) reported early results in six young patients using prebent rectangular steel rods and sublaminar wiring at L2. In our opinion, fixation devices which depend on the spinous processes or laminae are insecure because of the risk of fracture. Another factor is that the overall correction is greatest when the wedge is taken as low as possible in the lumbar spine (Fig. 4).

The results show that our method can provide sufficient correction without major complications. The average correction of 32° that we achieved at a single level is similar to that resulting from other methods (Jaffray et al 1992; Thiranont and Netrawichien 1993).

During correction the roots are continuously visible, and the risk of neurological damage is therefore reduced. The closing osteoclasis has an anterior cortical hinge and two cancellous surfaces ensuring rapid fusion and consolidation. The strong transpedicular H-frame instrumentation prevents unwanted displacement of the vertebrae during correction and gives good initial stability. We continue to use plaster-shell and plaster-cast fixation postoperatively because of the poor quality of the bone in this disease. The use of a circioelectric bed postoperatively may reduce superficial and deep-wound infections.

Our minimum follow-up is only six months (mean 22), but we consider that the correction obtained is unlikely to be lost after four months although kyphosis may continue to increase because of the underlying disease. We tried to define accurately the preoperative and postoperative curves, but it was often difficult to visualise the lumbosacral region directly on the postoperative radiographs. The 2.7° loss of correction which we report may be within the errors of measurement.

Closing-wedge posterior vertebral osteotomy with partial corporectomy and transpedicular fixation is a safe and predictable procedure. We advise it for patients of all ages with progressive spinal kyphosis due to ankylosing spondylitis at any stage of the disease.

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REFERENCES


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