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Osteotomy for kyphosis in ankylosing spondylitis

Twenty-two patients suffering from progressive kyphosis due to ankylosing spondylitis underwent one or more lumbar osteotomies during 1957–1983. The primary thoracic kyphosis was 80° (45°–155°). The mean correction obtained by one level osteotomy was 44° (30°–60°).
The mean loss of correction after 3 years was 5°. The use of internal fixation reduced the loss of correction from 9° to 1°, also allowing ambulatory after-care and a shorter period of immobilization in plaster or jackets. We had no fatal and relatively few non-fatal complications; three cases of retrograde ejaculation were observed however. All the patients reported subjective respiratory improvement.

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For a severe thoracic kyphosis, a compensatory lumbar lordosis of some 40°–50° can be produced relatively easily by sectioning a wedge of bone in the lumbar area, correcting the deformity, and maintaining the corrected position with or without internal fixation until the fusion consolidates. The osteotomy level with the least neurological risk is said to be L2–3 or L3–4. Smith-Petersen et al. (1945) were first to describe such a procedure, followed by La Chapelle (1946). Bossers (1972) reported four such cases without complications.

We can report 22 consecutive patients operated for progressive spinal kyphosis due to ankylosing spondylitis.

Patients and methods

From June 4, 1957 to August 13, 1983, 22 patients, affected by ankylosing spondylitis, had one or more spinal correction osteotomies for progressive kyphosis at our department. All patients were operated by one of the two senior authors (G.B. or G.S.). Most of the operations were done in the last few years. In this retrospective study, all the radiographs and the records as well as 18 patients were reviewed.

There were 20 male and two female patients. The average age was 41 (19–57) years. The known pre-operative duration of the condition varied from 7 to 36 years. The pre-operative sedimentation rate was 32 (7–104) mm.

In earlier years, radiographs were taken of the thoracic and lumbar spine and of the hips. Later, additional AP and lateral radiographs were made of the whole spine from the skull to the hips with the patient standing. Measurements were taken of the thoracic kyphosis curves from the highest visible intervertebral disc down to T12, and in the lumbar region from L1 to S1. The real thoracic curves were greater than the measured ones due to the fact that the highest thoracic disci, usually T1–T4, were not always visible on radiographs.

Only four patients had a lumbar kyphosis, not exceeding 10°. Of the 18 other patients, all had a slight lumbar lordosis of a few degrees, with five patients having a lordosis ranging from 20° to 70°. In the thoracic area the measured kyphosis ranged from 45° to 155° with a mean curve of 80°, usually with an apex in the high thoracic area. The ligamentum anterius was, except in one female, calcified at the thoracic spine, whereas no signs of ossification were found in more than half of the patients in the lumbar region. The radiographs of the cervical spine always revealed a lordosis, usually pronounced, sometimes with attrition of the mid and lower cervical corpora in the sagittal plane.

The hip joints were affected in most cases when the decision was made to correct the thoracic kyphosis. Only four patients had radiographically normal hips. Five patients had undergone hip arthroplasties before the osteotomy. For one patient, no radiograph of the hips could be found.

The most frequent complaints were gradual loss of horizon and cervical pain and muscle tension. Most patients had a C-shaped thoracic or thoracolumbar kyphosis with an almost totally rigid spine. Usually a slight movement was possible in the upper cervical spine.

Data on pre- and post-operatively performed *pulmonary function tests* were collected in 12 cases and in matched normal subjects. In the remaining 10 cases, the data were inadequate for comparison.

The purpose of the operation was to produce a compensatory lumbar lordosis. Usually a one-level lumbar dorsal wedge columnotomy was performed

with or without compression instruments. Harrington compression rods were used in the first few cases but later the modified Wisconsin compression system was preferred as it was easier to insert.

The osteotomies were located at L1–2 level three times, at L2–3 level 14 times, at L3–4 level four times and at L4–5 level once. A V-shaped wedge of bone, 45° oblique to the frontal plane, including spinous process, lamina, ligamentum flavum (usually ossified), articular process and a part of the floor and the roof of the intervertebral foramen were resected. The obliquity of the osteotomy ensured locking and this helped in controlling the rotational forces. The base of the wedge measured about 5 cm between the spinous processes and about 2.5 cm at the apex between the pedicles. The patients were operated in a prone position on a pre-bent table under general anaesthesia; hypotension was used during the last few years.

After the operation table had been extended, manual force was applied to the back of the patient, whose thorax and pelvis were supported by pillows. The spine usually "gave way", and sometimes a dry crack could be heard. The fulcrum of the corrective movement was located at the posterior border of the selected vertebral disc or vertebra. If compression instruments were used, they were tightened until obliteration of the wedge occurred, and the spondylodesis was completed by applying bone chips from the resected bone wedge. Sometimes cerclage wiring was used between the spinous processes above and below the osteotomy. When no manual osteoclasis was possible due to elastic resistance of the spine, a ventral discectomy was performed, usually retroperitoneally by a lumbar approach or by resection of the 12th rib, either at the same time or some weeks later. After discectomy, intercorporal fusion was performed by impaction of the resected rib into the prepared bed.

A dorsal plaster shell was applied for 2 weeks, followed by a thoracic plaster jacket with one or two leg-pipes for 3 months, with some patients being mobilized and some not. After this period, the type and period of external support varied because a number of patients had post-operative care supervised by their home-town orthopaedic surgeon.

Results

The mean correction by lumbar osteotomy was 44° (30°–60°) and in the 12 patients with internal fixation it was 42° (30°–55°) after 1 year (4 months to 2 years). No loss of correction occurred in nine paitents. In two patients the final correction measured 4° and 5° more than on the post-operative radiograph. One patient had a 23° loss during the first 3 months due to fracture of the lamina by a compression hook combined with an insufficient external support a plaster jacket *without* a leg pipe.

In the eight patients without internal fixation, the correction was 48° (32°–60°) after 4 (1–12) years. A slight loss of correction of 10° or less occurred in all patients, and in one patient the loss reached 40° in the first 3 months, also due to an inadequate plaster jacket *without* a leg pipe.

Two cases have been excluded from the overall results since they deserve a separate description. One patient had cervical osteotomy C6 to T1 successfully performed under local anaesthesia as described by Urist (1958) and Simmons (1972); a correction of 26° was obtained with no loss after 6 years. The other patient was a woman with a still flexible spine who in 1979 had a dorsal fusion with Harrington compression instrumentation from T_6 to L_1, and a lumbar osteotomy L_{1-2} with a total correction of 75°. One year later loss of correction measured 43°. The instrumentation was revised and fusion achieved from T_{10} to L_4 with a total correction of 44°. In 1983, the correction loss measured 52°. The instrumentation was once again revised, and fusion was performed from L_1 to L_5 with Harrington compression instrumentation and a new lumbar osteotomy performed at the L_{4-5} level, giving a 50° total correction and no loss after 1 year (Figure 1).

Manual osteoclasis was achieved easily in the 10 patients with a bamboo spine-burnt-out disease (Table 1). None of the other 11 cases (one patient had cervical osteotomy) showed any signs of disc calcification (disease not yet burnt out) with only one patient showing signs of calcification of the anterior longitudinal ligament. In three of these 11 cases a ventral discectomy was necessary.

Complications included pressure sores from plaster, temporary hypertension, gastro-intestinal problems, slight temporary or permanent neurological defects, urinary infections, and psychological setbacks including hallucination resulting in a fall out of bed with loss of correction, for which a new hyperextension plaster with a leg-pipe had to be applied. A dural tear with liquor leakage was noted in five cases. In

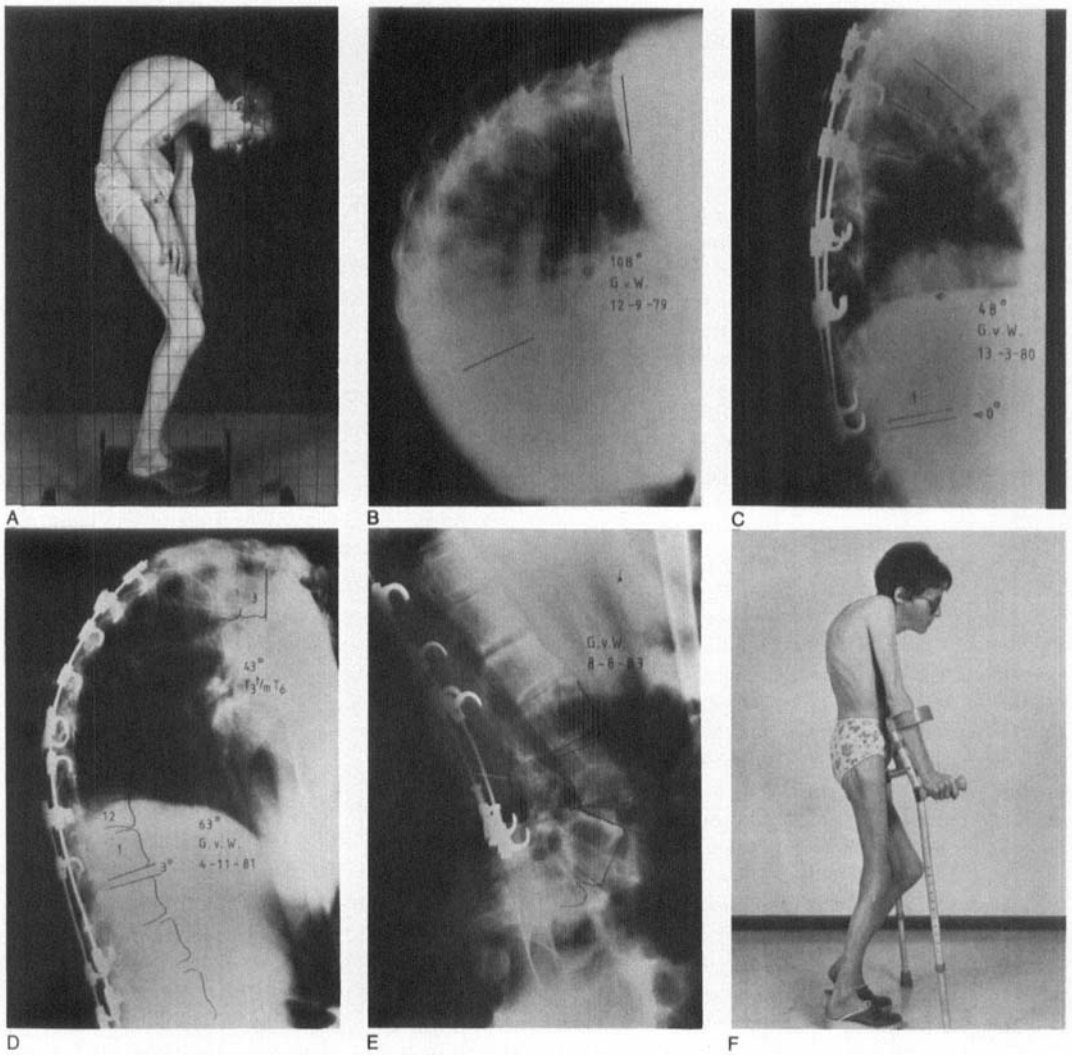

Figure 1. Results after repeated spinal osteotomies in a 40-year-old woman.
A. Preoperative appearance. The patient is unable to see the horizon in spite of compensatory flexion of the knees.
B. 1979. A part of a 155 degrees thoracic kyphosis preoperatively.
C. 1980. Using Harrington compression instrumentation, the spine was fused from T7 to L1 with a 60 degrees correction, due to mobile, non-calcified disci.
D. 1981. Progression of kyphosis with wire breakage.
E. 1983. Fused lumbar spondylodesis including L5 with Harrington compression instrumentation with some 80 degrees compensatory lordosis achieved from L3 to S1.
F. Postoperative appearance.

Table 1. Type of correction in 22 patients with spinal osteotomy

	Frequency
Intradiscal-intervertebral separation	9
Infraction dorsal part of vertebra with:	
– anterior ligament and disc intact	4
– intradiscal disruption	4
Fracture disruption of end plates, disc intact	1
intervertebral osteotomy with osteotome	1
Ventral discectomy	3

two cases the dura was sutured, in the other three cases Spongostan® was placed on the dura. All five recovered uneventfully. Further, retrograde ejaculation problems were noted on three occasions, two of which were permanent.

Pulmonary function. The mean volumes of total capacity were 5.6 l pre-operatively and 5.8 l post-operatively (normal value 7.0 l). The mean volumes of vital capacity of 3.5 l re-

mained unchanged (normal value 5.0 l). The mean volume of maximal expiration in one s of 2.5 l also remained unchanged (normal value 3.5 l). However, all patients experienced improved respiration.

Finally, the patients became on average 6 cm taller after the operation.

Discussion

McMaster (1962) stressed the need for adequate support for 1 year following the operation. We found that the use of compression rods reduced the loss of correction while allowing ambulatory aftercare. The post-operative support for 3–6 months by a thoracic plaster *with* a leg-pipe together with internal fixation should prevent loss of correction.

Smith Peterson et al. (1945) stated that the less marked the ossification of the ligament and disc space, the better the chance of correction. La Chapelle (1946) thought that ossification of the anterior longitudinal ligament prevented correction. Herbert (1948, 1959) believed that posterior osteotomy alone was insufficient in cases with a considerable degree of ossification of the anterior longitudinal ligament. Law (1969) determined the level of the osteotomy by the least degree of ossification anteriorily. On the contrary, we found that manual osteoclasis is easier if there is calcification of the discoligamental intervertebral structure in the lumbar area; the elastic resistance of this non-ossified tissue made a ventral discectomy necessary in three cases. Also, we have an impression that the disease is not burnt out if there is no radiographic evidence of calcification of the discoligamental structures, especially in the thoracic spine. Our most severe case supports this view; progressive kyphosis, partly due to anterior wedging of the still elastic non-calcified intervertebral discs, continued in spite of repeated Harrington instrumentation spondylodeses.

McMaster (1962) reported three different types of correction: (1) anterior separation of two intact vertebral bodies, (2) fracture transversely through a vertebral body with intact anterior ligaments, and (3) infraction and compression of the posterior part of the vertebral body with separation of the anterior body surface with intact anterior ligaments. To these we would add the following: (4) fracture separation of the neighbouring end-plates with an intact non-calcified disc, (5) infraction and compression of the dorsal part of a caudal vertebra, with anterior intradiscal separation of intact ventral parts of two vertebral bodies, (6) infraction and compression of 50 per cent of the dorsal part of one vertebral body with intact anterior ligaments, and (7) intravertebral separation after osteotomy of the vertebra from behind.

To the numerous complications found in literature, we have to add three cases of retrograde ejaculation. We have had no fatal compliations and we think that the number of non-fatal complications can still be reduced with more attention to technical details, better post-operative care and adequate support of patients in a plaster with a leg-pipe, allowing them to be ambulatory if a solid internal fixation has been achieved.

Unlike Bossers (1972), we found that total respiratory capacity was surprisingly high, and the subjective respiratory improvement found in all the patients could not be explained by an improved vital and total capacity.

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