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Harrington instrumentation for thoracic and lumbar vertebral fractures

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Thirty-seven patients with fractures of the thoracic and lumbar spine treated with Harrington instrumentation were reviewed. Twenty-seven patients with a follow-up time of more than 2 years were summoned for a clinical and radiographic examination. This report presents the results related to reduction, stabilization, return of neural function, spinal posture and mobility, and residual disability. It is concluded that Harrington instrumentation can be performed without a substantial number of complications. Its major advantages are early mobilization and ambulation. The operative technique is discussed with special reference to the preservation of the normal configuration of the back. The value of computerized tomography in the preoperative assessment is stressed.

Key words: computerized tomography; Harrington instrumentation; spinal mobility; vertebral fractures.

With the advent of Harrington's spinal instrumentation, a biomechanically efficient method of treating various spinal deformities became available. The method was soon used in the management of unstable thoracic and lumbar fractures (Harrington 1967), and it is now an established procedure in most spinal centers (Dickson et al. 1973, 1978, Flesch et al. 1977, Yosipovitch et al. 1977, Jacobs et al. 1980, Osebold et al. 1981). Harrington's technique compares favourably with conservative treatment as well as with older methods of spinal stabilization (Williams 1963, Lewis & McKibbin 1974, Weiss 1975, Roy-Camille et al. 1976, Jacobs et al. 1980, Soreff et al. 1982). Among its advantages are earlier and easier rehabilitation, decompression of the neural elements by effective reduction and stabilization, and the prevention of late deformity. The present paper is a retrospective study of patients with fractures of the thoracic and lumbar spine treated with Harrington instrumentation.

Patients and methods

The hospital records and radiographs of 37 consecutive patients with thoracic and lumbar fractures operated on according to Harrington's method at the Department of Orthopaedic Surgery, Huddinge University Hospital, were reviewed (Table 1). Patients with pathological fractures and those having had surgery for late traumatic deformities were excluded.

Twenty-seven patients with a mean follow-up of 34 months (range 24–55) were called for a detailed clinical and neurological examination. The mean age was 30 years, and there were 13 flexion-rotation injuries, five burst fractures, six multiple compression fractures, and three hyperextension injuries. Posture and spinal mobility were measured with a kyphometer (Debrunner 1972). The clinical interview was supplemented with a questionnaire regarding residual symptoms, working capacity, and social situation. Each patient was requested to draw on a form the location and modality of his pain – this method has proved valuable in the interpretation of clinical pain conditions (Ransford et al. 1976). The spine was radiographed in standing and reclining positions.

The operation was performed under general anesthesia with the patient placed on a Relton-Hall frame. A standardized technique was used. When the distraction system was used, hooks were placed on the third vertebra above and third vertebra below the fractured vertebra. When the distal hooks were placed on the sacrum, the sacral alar hook of Moe was used with a square-shaped hole (Moe et al. 1978). The rods were bent to suit the normal configuration of the spine. In the lumbar spine one compression rod was often added to preserve the lumbar lordosis. For compression fractures sometimes only the compression system was used, and then at least two hooks were placed above and two hooks below the injured segment. Thoracic fracture-dislocations

Table 1. Patient data

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	X	Y	A
1	37	F	L1	FR	F	–	MD	13	L (13)	2 DR	L	15°	7°	10°	UTI	–	EE	–	–	–	–	–	a	1
2	37	F	L2	FR	F	–	–	6	–	2 DR	L	10°	2°	5°	DVT	44	EE	0	0	0	2	SL	–	2
3	34	M	L1	FR	AA	–	–	1	PL (1)	2 DR	S	15°	5°	7°	–	32	DD	2	2	2	1	W	b	3
4	17	F	L2	FR	F	7	–	2	–	2 DR 1 CR	S	15°	3°	6°	–	–	EE	–	–	–	–	–	–	4
5	18	F	L1	FR	F	–	MD	1	–	2 CR	S	14°	0°	3°	–	34	EE	0	0	0	1	W	–	5
6	39	F	L1	FR	F	2,3,7	MD	0	PL (0)	2 DR	S	30°	5°	5°	–	–	EE	–	–	–	–	–	–	6
7	27	F	L1	FR	F	1,5,6,7	–	1	PL (1)	2 DR	L	20°	0°	5°	–	55	DD	3	3	3	1	P	–	7
8	23	F	L4	FR	F	–	AB	2	PL (2)	2 DR	S	14°	7°	15°	NR UTI	44	DD	0	0	0	0	W	c	8
9	21	F	L1	FR	F	7	AB	0	PL (0)	2 DR	S	12°	0°	5°	SU	24	DE	0	0	0	1	UE	–	9
10	28	F	L2	FR	F	7	–	7	–	2 DR	L	35°	8°	10°	–	35	AA	3	3	3	0	P	–	10
11	18	F	T12	FR	F	–	–	38	L (1)	2 DR	L	18°	5°	10°	–	52	AE	3	0	0	0	W	d	11
12	27	F	T11	FR	F	3,5,7	–	10	–	1 DR 1 CR	S	20°	4°	6°	–	31	EE	0	0	0	1	W	–	12
13	31	F	L1	FR	F	5	MD	4	–	2 DR	L	12°	0°	–	DVT PE	–	DE	–	–	–	–	–	–	13
14	15	F	L5	FR	AA	–	–	12	–	2 DR	L	20°	17°	18°	–	36	EE	0	0	0	1	W	–	14
15	16	F	L2	FR	F	1,5	–	2	–	2 DR	S	20°	8°	10°	DVT	25	EE	0	0	0	1	W	–	15
16	25	M	L1	FR	MA	5,6	–	36	L (1)	2 CR	L	40°	0°	20°	–	35	AA	3	3	3	3	P	–	16
17	16	F	L1	FR	MA	–	–	3	–	1 CR 1 DR	S	19°	2°	3°	–	24	EE	0	0	0	1	W	–	17
18	48	F	L1	FR	F	3,4	MD	1	L (1)	2 DR 1 CR	L	31°	15°	15°	–	–	EE	–	–	–	–	–	–	18
19	35	M	L3	FR	DB	3	–	1	–	2 DR 2 CR	S	45°	5°	–	DR	–	CD	–	–	–	–	–	–	19
20	28	F	L1	FR	F	–	–	2	–	2 DR 1 CR	S	5°	0°	–	–	–	DE	–	–	–	–	–	–	20
21	31	F	L1	BF	F	–	AB	1	–	2 DR	–	22°	3°	10°	–	24	EE	0	1	0	2	SL	–	21
22	25	F	T9	BF	AA	1,3,5	–	25	–	2 DR 2 CR	L	28°	10°	15°	UTI	35	AA	3	3	3	0	P	–	22
23	42	F	L3	BF	F	1,6	AB	1	–	2 DR 2 CR	S	30°	5°	10°	DT	25	DD	3	1	2	2	P	–	
24	29	F	L2	BF	F	5	–	3	L (3)	2 DR	L	7°	4°	5°	DR	36	DE	0	0	0	0	W	–	24
25	37	F	L3	BF	AA	6	–	47	–	2 DR	L	10°	5°	10°	DR	47	EE	0	0	0	0	W	–	25
26	33	M	L2	BF	F	6	MD	0	–	2 DR	L	30°	5°	0°	DVT PE	–	EE	–	–	–	–	–	e	26
27	41	M	L2	BF	F	–	–	5	L (5)	2 DR 1 CR	S	16°	5°	–	–	–	DE	–	–	–	–	–	–	27
28	17	M	L5	BF	AA	–	–	12	L (12)	2 DR	S	*)	–	–	–	–	DE	–	–	–	–	–	–	28
29	54	F	T12+ L1	MC	F	–	OP	3	–	2 DR	L	60°	10°	15°	–	30	EE	0	0	0	1	SL	–	29
30	43	M	L1– L3	MC	F	–	–	9	–	2 DR	S	60°	10°	12°	–	28	EE	0	0	0	2	W	–	30
31	18	M	T5–7	MC	AA	–	–	6	–	2 CR	L	40°	15°	20°	–	43	EE	0	0	0	0	W	–	31
32	19	F	T6–8, 10	MC	AA	–	–	16	–	2 DR	S	45°	20°	20°	–	25	EE	0	0	0	1	UE	–	32
33	34	F	T12, L1	MC	F	–	AB	5	–	2 DR	L	15°	4°	7°	–	43	EE	1	1	1	2	P	–	33
34	28	F	T4,5, 8	MC	F	–	–	8	–	1 DR 1 CR	L	40°	15°	21°	–	24	EE	0	0	0	0	W	–	34
35	70	M	T6–7	Lux	BA	3,4	–	23	–	2 CR 2 DR	L	+)	–	–	CA	35	AA	3	3	3	0	P	–	35
36	56	M	T7	Lux	AA	3	–	25	–	2 DR 2 CR	L	+)	–	–	WI	27	AA	3	3	3	1	SL	–	36
37	21	M	T5	Lux	AA	3	–	35	–	2 CR	L	+)	–	–	–	35	AA	3	3	3	1	P	–	37

Key to data in Table 1.
A. Case number.
B. Age.
C. Sex.
D. Level of injury.
E. Type of injury.
F. Cause of injury.
G. Associated injuries: 1. injury of the head; 2. fracture of the cervical spine; 3. thoracic injury; 4. abdominal injury; 5. fracture of the upper extremity; 6. fracture of the sacrum and/or the pelvis; 7. fracture of the lower extremity.
H. Associated morbidity: MD, mental disease; AB, drug abuse, and/or alcoholism; OP, osteoporosis.
I. Time of instrumentation (days after injury).
J. Decompression (days after injury): L, laminectomy; PL, posterolateral decompression.
K. Type and number of rods: DR, distraction rod; CR, compression rod.
L. Fusion: L, long; S, short.
M. Preoperative kyphotic deformity (degrees): *) moderate compression, but a large fragment in the spinal canal; +) unstable dislocation, reduced to a good position.
N. Postoperative kyphotic deformity.
O. Final kyphotic deformity.
P. Complications: UTI, urinary tract infection; DVT, deep venous thrombosis; PE, pulmonary embolism; DR, dislodged rod; BR, broken rod; CA, cardiac arrest; S, skin ulcerations; WI, wound infection.
Q. Length of follow-up (months).
R. Neurological function graded according to Frankel et al. (1969). The first letter in the column refers to the preoperative condition, the second to follow-up. AE, for instance, means total paraplegia with complete recovery. A: complete paraplegia; B: as A, but some residual sensation; C: some motor power below the injury, but of no practical use to the patient; D: useful motor power below the lesion; E: no neural deficit.
S. Urinary dysfunction preoperatively *).
T. Urinary dysfunction at follow-up *).
U. Sexual dysfunction at follow-up *).
V. Pain at follow-up *).
*) 0, no symptoms or dysfunction; 1, slight; 2, moderate; 3, severe.
X. Social situation: UE, unemployed; P, pensioner; SL, sick listed; W, working.
Y. Comments: a. moved abroad; b. CT-scan postoperatively showed a large fragment in the spinal canal; c. complete paraplegia; at laminectomy the cord had a normal appearance. Neurological restitution in a few days – commotio medullae spinalis?; d. committed suicide 1 year after the accident; e. fatal pulmonary embolism 10 days after the injury.

with complete loss of spinal cord function were stabilized with two distraction and two compression rods. No external support was used in these cases. For decompression of thoracolumbar and lumbar fractures a posterolateral approach was used (Flesch et al. 1977). Posterior fusion with autogenous bone graft was performed in all cases but one. The fusions were as short as possible, optimally one segment above and one below the fracture.

Postoperatively, the patients were managed on regular beds. On the first postoperative days they were turned with the log-rolling technique, but as soon as the pain had subsided, they were allowed to turn freely. They stayed in bed until the brace was ready – generally for about 2 weeks. Patients with thoracic fractures had Milwaukee braces and those with thoraco-lumbar or lumbar fractures had hyperextension braces. The hyperextension braces were made from plaster models of the patients and extended from the pelvis to the manubrium sterni. The patients were taken out of bed and mobilized as fast as their general condition allowed, and the braces were worn for 5 months. The average duration of stay in our hospital was 51 (10–278) days. The patient with the longest hospital confinement had a postoperative wound infection and septicemia requiring prolonged intensive care and repeated plastic operations (case 36).

Student's t-test was used in the statistical calculations.

Results

The results were considered in terms of pain, neurologic recovery including sexual and urinary functions, working capacity, radiographic evaluation, spinal posture and mobility, and complications.

Pain

Five patients reported slight to moderate low back pain before the injury. Three of these patients claimed increased pain after the injury. At follow-up nine had no back pain, 12 had intermittent mild pain not interfering with activity, and five patients had moderate pain which limited their activity. One patient had a severe pain condition (Case 16, case report). Two patients had a large and continuous consumption of analgesics. Six patients took analgesics more than occasionally, while 19 patients seldom or never used analgesics.

No significant relation between pain and angular deformity at follow-up could be demonstrated.

An analysis of the pain drawings showed that the patients with cord and root lesions presented drawings similar in character, which corresponded to the anatomical lesions. The other patients with persistent back pain made drawings in which we failed to recognize a pattern referable to an organic lesion. In fact, their drawings were quite similar to those of an unselected population of patients with low back pain (E. Spangfort, personal communication).

Twelve patients with lumbar fractures had their rods extracted. Eight patients reported decreased back pain; in two, the condition had deteriorated and two reported no change; similar answers were obtained for subjective stiffness, but these parameters were not correlated. After rod extraction in four patients with thoracic fractures, one had slightly increased pain while three were improved. One patient reported less stiffness, while three remained unchanged.

Neurologic function

In no patient did the neurologic function deteriorate postoperatively. Fourteen patients had no neurologic impairment on admission. Of the four patients with persistent partial paraplegia grade D, three complained of urinary symptoms; one used intermittent catheterization, while three had various mild disturbances. None of these had a chronic urinary tract infection. Among those with complete paraplegia grade A, one had a portable urinal, one used intermittent catheterization, two emptied by the Créde maneuver, and one patient had chronic urinary tract infection.

Working capacity

At follow-up none of the patients with complete paraplegia had managed to return to employment. Of the four patients with partial paraplegia, two were back at work and two had disability pensions. Among the 16 patients without residual neurologic losses, 11 had gone back to work, two were unemployed, and three patients were unable to work because of chronic back pain.

Radiographic evaluation

In the five burst fractures the average kyphotic deformity was 20 degrees before operation, 5 degrees afterwards and 10 degrees at follow-up. Corresponding values for the six multiple compression fractures were 43 degrees preoperatively, 12 degrees postoperatively, and 15 degrees at follow-up. In the 13 patients with flexion-rotation injuries the average initial deformity was 20 degrees, the postoperative kyphosis 4 degrees and the final deformity 8 degrees. In the patients with flexion-rotation injuries the extent of anterior dislocation was recorded as a percentage of the cranial vertebra: before operation 20 per cent, after operation 8 per cent, and at follow-up 10 per cent.

Spinal posture and mobility

The thoracic kyphosis and lumbar lordosis could be measured in 26 patients, with mean values of 30 ± 11 degrees and 21 + 13 degrees, respectively. The average sagittal mobility of the thoracic spine was 39 ± 12 degrees and of the lumbar spine 63 ± 22 degrees.

To see whether the mobility of the lumbar spine increased after removal of the rods, the lumbar mobility of six patients with fractures instrumented from the lower thoracic spine to L4 was compared to that of ten scoliotic patients who had the lumbar spine fused down to L4. The mean age of the scoliotic patients was 7 years less than the fracture group. The average mobility of the patients who had the rods removed was 71 degrees, compared to 48 degrees for the patients with a fused spine. This difference was significant at the 1 per cent level.

Complications

Among 15 of the 37 patients, 17 complications occurred. Four patients had deep venous thrombosis; and two of these had pulmonary embolism, one of which was fatal. One patient had a postoperative infection with severe septicemia. Another patient developed skin ulcerations during bracing. There were three cases of urinary tract infections, three dislodged rods and one each of the following: delirium tremens, cardiac arrest with complete recovery, and a broken rod.

Case reports

Case 35. A 70-year-old man was hit by a fast-going boat while fishing from a small boat. He sustained a fracture dislocation T6–T7 of hyperextension type with complete paraplegia, multiple rib fractures with pulmonary contusions and rupture of the ileum. Soon after admission, bowel resection and tracheostomy were performed and he was given assisted ventilation.

There was a total dislocation between T6 and T7 which could not be reduced by manipulation. As the patient's general condition improved, he was referred to us for spinal surgery. Twenty-three days after the accident, open reduction, posterior fusion, and fixation with two compression rods and two distraction rods was performed. About 50 per cent contact between the bodies of T6 and T7 was obtained. Twenty-seven days postoperatively when he was taken off the respirator he had a cardiac arrest, but was successfully resuscitated and a temporary pacemaker was implanted. His neurologic function has not improved. Three years later he is conducting a relatively independent life in a specially equipped apartment. His back is stable, pain-free, and without deformity. Conservative treatment would have required prolonged recumbency, entailing a high risk of fatal cardiac or pulmonary complications and would hardly have resulted in bone healing. Preoperatively, it was questioned whether a posterior fusion would be sufficient. Considering the frail condition of the patient, we abstained from performing an anterior fusion primarily, and it later proved to be unnecessary.

Case 27. A 41-year-old man fell 6 metres and had a burst fracture of L2 with lesions of the L5 and S1 roots on the right side. Radiographs showed no major dislocation (Figure 1). Computerized tomography, however, demonstrated marked narrowing of the spinal canal. At operation, the intervertebral joints were found to be subluxated, and a bone fragment was removed. Two distraction rods and one compression rod were used for stabilization. There has been an improvement of the neurologic losses.

Case 16. A 25-year-old man was involved in a motorcycle accident and had a flexion-rotation injury of L1 with complete paraplegia, an acromioclavicular luxation and a stable pelvic fracture. The following day an extensive laminectomy was performed as an isolated procedure at another hospital; the conus medullaris and the nerve roots were found to be completely torn. About a month after the accident the patient experienced increasing burning and aching pain in the legs. He was referred to us, and because of progressive deformity, open reduction, fixation with two compression rods and a posterior fusion were performed 36 days after the injury. The fusion healed, but the pain worsened during the following months. Three years after the injury the patient is suffering from incapacitating pain and he is constantly taking large amounts of analgesics and narcotics. This is an example of the futility of laminectomy in traumatic paraplegia. Furthermore, the operation increased the instability in this inherently unstable injury, making bone healing under conservative treatment a most unlikely event. This patient is suffering from phantom body pain, which is said to occur in about 30 per cent of the patients with cord transections; in at least 5 per cent the pain is severe and notoriously resistant to all kinds of treatment, including neurosurgery (Melzack & Loeser 1978).

Discussion

Preoperative assessment

The question whether an injury is stable or not can often be settled at the clinical examination; rupture of the posterior ligament complex and separation of the spinous processes can readily be palpated. In the radiographic assessment we have used the criteria of Holdsworth (1970), but, in accordance with Miller and associates (1980), we think that some burst fractures with extensions through the pedicles and/or laminae are unstable. These fractures can often be diagnosed by separation of the pedicular shadows as seen on the AP-radiograph.

Twenty-three of the fractures were considered to be unstable, while eight were operated on because of bone fragments in the spinal canal. Finally, the indication for surgery in the six patients with multiple compression fractures was to prevent the development of progressive late deformity.

Computerized tomography is a powerful tool in the preoperative evaluation (Nykamp et al. 1978, Fredrickson et al. 1982). It is particularly valuable in burst fractures where conventional radiography often fails to demonstrate significant pathologic anatomy such as the true extension of the fracture system, fractures of the neighbouring vertebrae and fragments in the medullary canal. Furthermore, in most cases it is possible to obtain postoperative computerized tomograms without too many scatter artifacts from the rods. One of our patients (Case 3) was reoperated when the postoperative computerized tomogram revealed a fragment in the spinal canal not visualized by conventional radiographs. Conventional tomography and myelography, on the other hand, have not given us information which affected the clinical decisions.

Postoperative evaluation

Pain. Nine patients were pain-free, a rather low figure compared with earlier reports of thoracolumbar fractures treated with Harrington instrumentation. Thus, Osebold et al. (1981) found that 61 per cent of their patients were pain-free. Flesch et al. (1977) reported that 4 out of 40 patients had persisting low back pain. These figures are to be compared with a recent Swedish investigation (Svensson 1981) which showed a prevalence of low back pain of 31 per cent among an unselected population of middle-aged men. The assessment of residual pain is a difficult task, not least because of its entirely subjective nature.

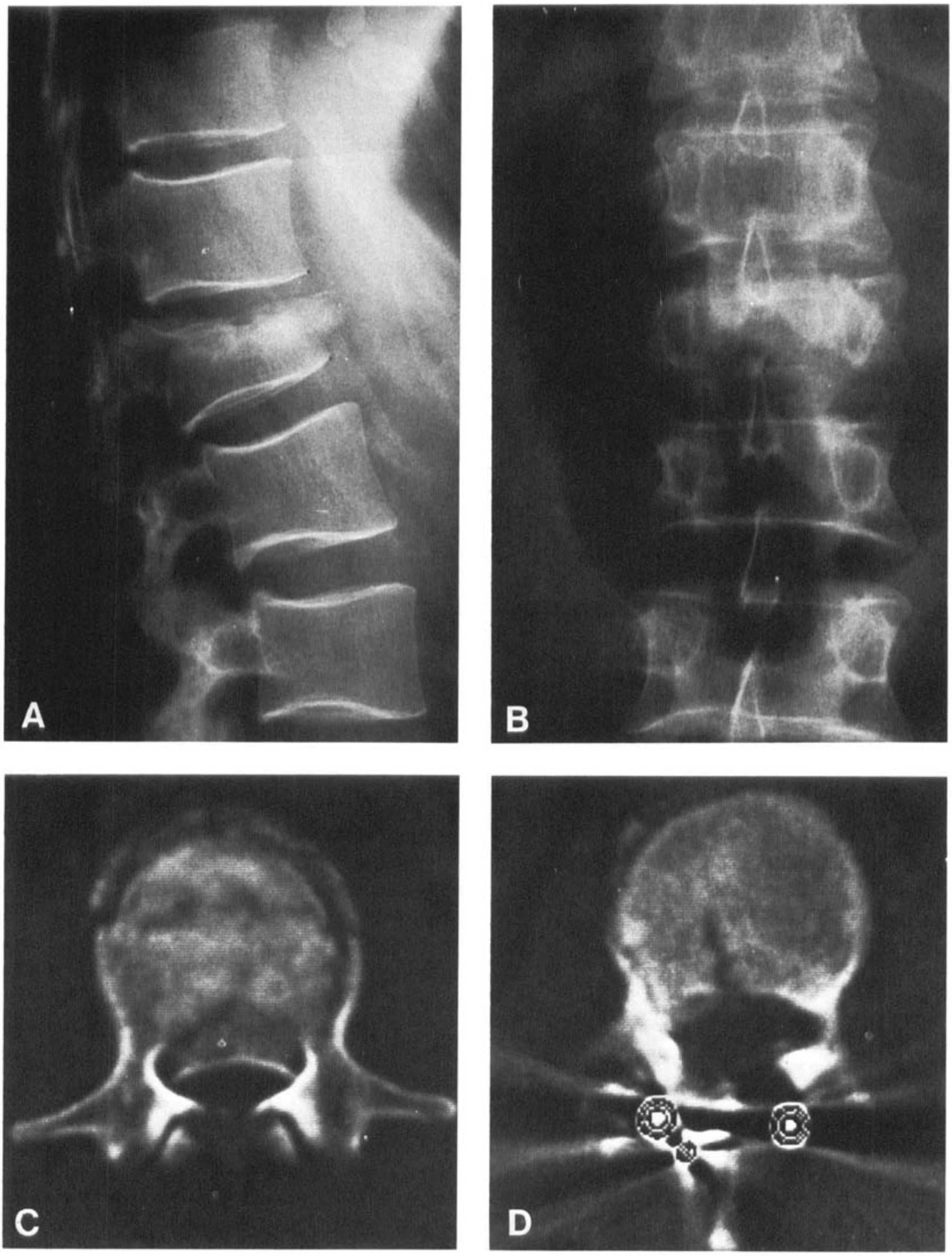


Figure 1. A 41-year-old man with a burst fracture of L2 with root lesions (Case 27).
A. Preoperative lateral radiograph.
B. Preoperative A–P radiograph.
C. Preoperative computerized tomography; note marked narrowing of the spinal canal.
D. Postoperative computerized tomography.

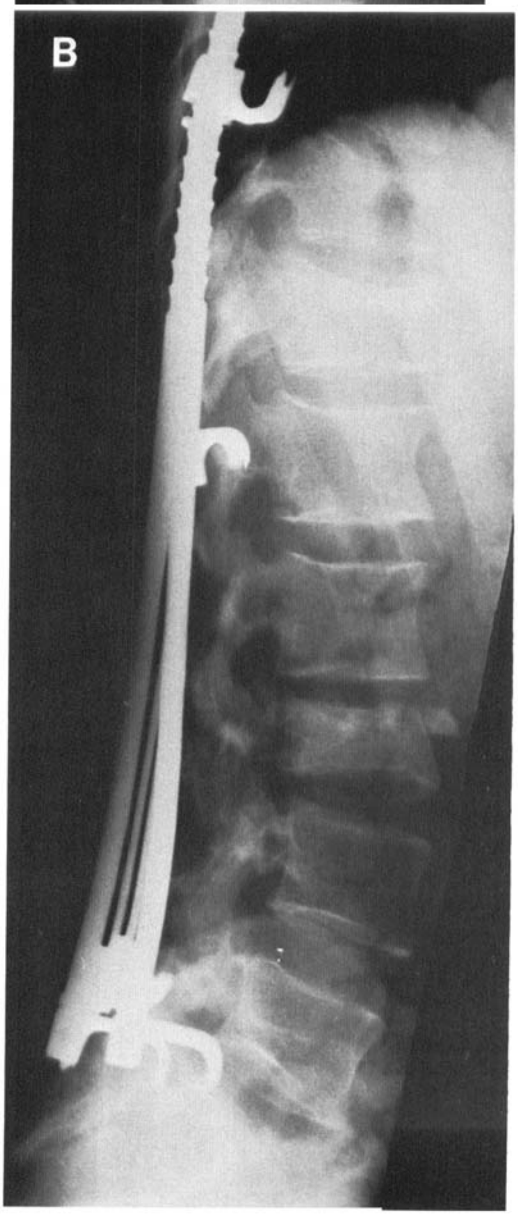
The low working capacity and high incidence of residual back pain in the present material are rather discouraging. However, the high incidence of mental illness among our patients as well as the social security system in Sweden, and the present unemployment problem undoubtedly have a great impact on the total residual disability as recorded.

Neurologic recovery. As Guttman (1973) has noted, the most important factor determining neurologic recovery is the damage sustained by the nervous tissue at the time of the accident. Though it is not proven that any particular form of treatment improves neurologic recovery, several authors have gained the impression that decompression has a beneficial effect. Flesch et al. (1977) noted the satisfactory decompression often obtained by instrumentation and reduction of the fractures, stressing the fact that the site of neural compression is anterior to the dural sac. Hence, they recommended the posterolateral approach and decompression, preferably by undermining the cortex of the intruding fragment and then fracturing it anteriorly. Mostly, however, we found it more convenient to remove displaced fragments. Contary to Riska (1976), Whitesides & Shah (1976) we have not found it necessary to use an anterior approach. Because of the multitude of variables, a comparison between various reports is difficult. The Frankel et al. (1969) rating system (Table 1) seems to be appropriate in such studies. Nevertheless, several of our patients within the group D–D, which has a rather large span, obtained a substantial recovery of neural function. Some of our patients had previously been subjected to laminectomy. We think that this operation is disadvantageous for the patient, firstly because it increases the spinal instability and secondly because it may cause the neurologic function to deteriorate. Morgan et al. (1971) reported that of 42 patients with incomplete lesions of the spinal cord who had undergone laminectomy, 22 patients lost neurologic function following surgery, and fewer patients had neurologic recovery compared to an unoperated group. Like Dickson et al. (1978), we failed to demonstrate a positive effect of Harrington instrumentation on neurologic recovery, though we think that such a beneficial effect is most probable.

Radiographic evaluation. The radiographic results were comparable to those of earlier materials. Thus, in an investigation of 95 patients treated with Harrington instrumentation, Dickson et al. (1978) found an initial mean deformity of 31 degrees, a postoperative deformity of 11 degrees, and at follow-up a kyphosis of 15 degrees. Our failure to demonstrate a relation between the quality of reduction and the clinical results can probably be explained by the wide heterogenicity within the groups in our small material.

Spinal posture and mobility. In the follow-up the thoracic kyphosis was within normal limits while the lumbar lordosis was smaller compared to a normal population (Aaro & Öhlén 1983). The tendency of the Harrington distraction system to straighten the normal sagittal curves has been demonstrated earlier (Aaro & Dahlborn 1982, Aaro & Öhlén 1982). After instrumentation there is often a loss of the normal lumbar lordosis, which increases the deformity caused by fractures of the lumbar spine, and the addition of a compression rod in the lumbar region is therefore to be recommended (Figure 2). Furthermore, this increases the stability of the fracture fixation system (Simmons 1970). It is also probable that the tendency for the angular deformity to recur in burst fractures (Gertzbein et al. 1982) is less if the lumbar spine is rigidly fixed in a normal lordotic position.

The loss of lumbar lordosis gives an unattractive appearance, especially in women. Moreover, the patient develops a tendency to lean forward; to compensate for this, she has to extend the thoracic spine and, in extreme cases, even bend the knees. This leads to fatigue and pain in the back, and sometimes an awkward gait. Regarding patients with thoracic fracture it is doubtful if removal of the rods is necessary. The total sagittal mobility of the thoracic spine is only 50 per cent of that of the lumbar spine and the patients do not notice the addition of one or two vertebrae to the fusion (Aaro & Öhlén 1982). For these patients it is better to incorporate the rods in the fusion, thus avoiding later extraction of the rods.



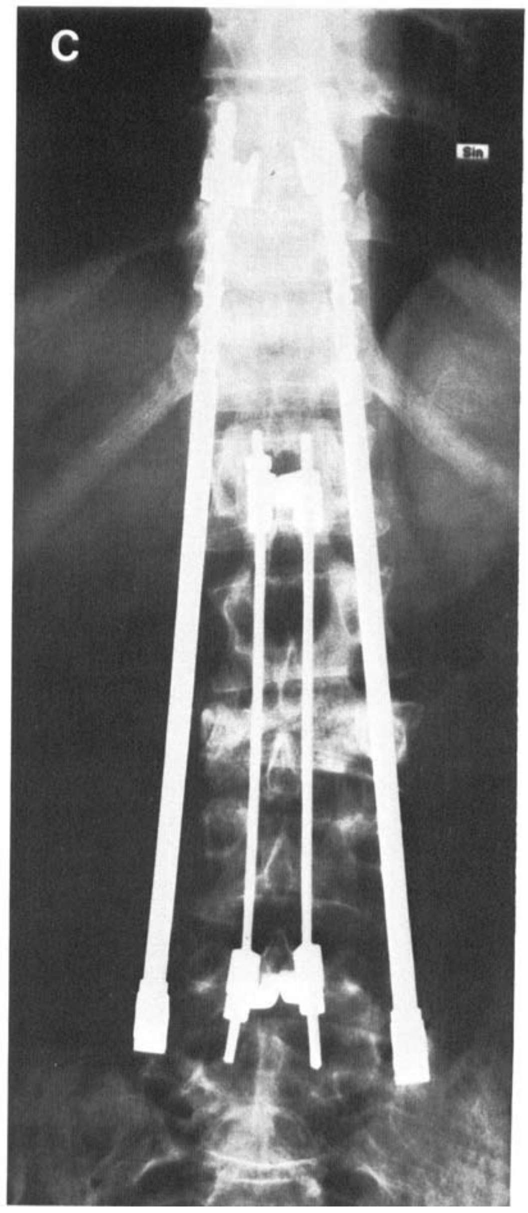


Figure 2. A 35-year-old man with a flexion-rotation injury with paraplegia (Case 19).

A. Preoperatively.

B. Postoperative lateral radiograph. Note the preservation of the lumbar lordosis, achieved by bending the distraction rods and by using compression rods.

C. Postoperative A–P radiographs.

Complications. There were six serious complications. The four thromboembolic complications can probably not be blamed on the operation *per se*. One paraplegic patient (Case 36), who previously had been subjected to laminectomy abroad, was reoperated 25 days after the injury. Preoperatively, he had a decubitus ulcer over the sacral area, and he suffered a severe postoperative infection. A multiresistant strain of *Staphylococcus aureus*, not previously encountered in our hospital, was cultured.

One patient (Case 25) was sent to us for reoperation because of progressive deformity after the Harrington rods became dislodged 3 weeks postoperatively. This complication can be ascribed to incorrect placement of the hooks. One patient had a rod fracture 1 year postoperatively, and in another (Case 8) a dislodged rod was unexpectedly seen on the follow-up radiographs. However, both these patients were symptom-free and refused extraction of the implants. Finally, in one patient (Case 19) the rods dislodged 8 months after the operation, and were subsequently removed. It is biomechanically inevitable that rods spanning unfused segments will either break or dislocate In patients with short fusions we now routinely remove the rods 9 months after the primary operation.

Kümmel was the first to describe progressive deformity after spinal trauma (Kümmel 1891, as cited by O'Brien 1931). Stanger (1947) found in a long-term study of 43 patients with fractures and fracture dislocations of the thoracolumbar spine, conservatively and/or operatively treated, that there was a marked tendency to recurrence of the deformity. Moreover, malunited thoracolumbar fractures have been shown to give a higher incidence of residual symptoms than previously thought. Thus, Soreff (1977) found in an investigation of the late results of 147 conservatively treated thoracic and lumbar compression fractures that only 9 per cent of the patients were completely symptom-free. It seems probable that Harrington instrumentation will improve the long-term prognosis for patients with unstable or severely dislocated thoracic and lumbar fractures. Previous reports on the short-term results have stated that Harrington instrumentation and fusion reduce morbidity and shorten hospitalization and rehabilitation time for patients with unstable fractures with or without neurologic losses. Our experiences are in accordance with those of Dickson et al. (1973, 1978), who claimed that early mobilization and ambulation are the major advantages of Harrington instrumentation.

Of the available vertebral fracture fixation systems the Harrington system is the most versatile, allowing distraction as well as compression. The instrumentation assembly is easy to handle and reduction is easy by powerful distraction provided that the anterior longitudinal ligament is intact. The combination of both the distraction and the compression systems gives the possibility of preserving the normal sagittal configuration of the back and gives a very stable fixation.

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