Spinal canal remodeling after thoracolumbar fractures with intraspinal bone fragments

17 cases followed 1–4 years

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The long-term fate of nonreduced intraspinal bone fragments in 17 thoracolumbar fractures—three not operated on and 14 stabilized with Harrington's rods or a Hartshill rectangle—was studied with CT. The reduction of the spinal canal area was measured in conjunction with the trauma in the nonoperated on cases and immediately after surgery in the other cases. The mean reduction was 29 (10–70) percent. The reduction had decreased to 14 (0–30) percent at the follow-up examination 31 (12–44) months later. The restitution of the spinal canal did not differ in the nonoperated and operated on patients. Our findings indicate that stable thoracolumbar fractures with intraspinal bone fragments, but without neurologic symptoms, can be treated nonoperatively, irrespective of the size of the fragment, without risk of subsequent symptomatic neural compression.

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Operative treatment is a rational way of dealing with unstable spinal fractures with or without neurologic lesions, as well as with stable fractures with intraspinal bone fragments and neurologic deficits. The presence of a large bone fragment in the spinal canal of a stable vertebral fracture without neurologic symptoms has also been considered an indication for surgery to prevent subsequent symptomatic neural compression (Bohlman 1985). However, there are indications that the risk of future symptoms of spinal stenosis is negligible due to remodeling of the spinal canal (Krompinger et al. 1986, Fidler 1988).

In this study, CT was used to determine the long-term fate of nonreduced intraspinal bone fragments in operated and nonoperated on thoracolumbar fractures.

Patients and methods

This study included 17 (10 females, 7 males) consecutive patients below aged 60 (mean 31 [18–58]) years with operated and nonoperated on thoracolumbar fractures with CT verified non-reduced major intraspinal bone fragments (Table 1).

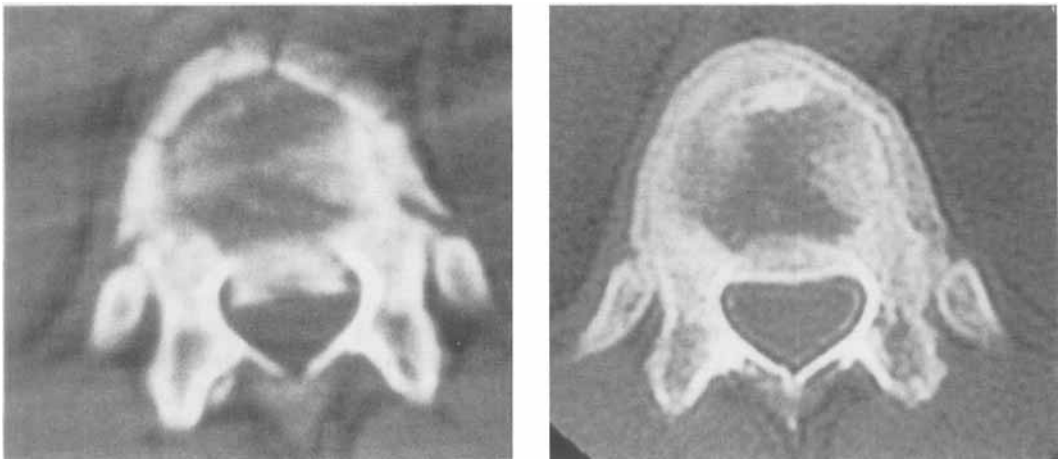

Figure 1. Case 12. Th-12 fracture with an intraspinal bone fragment (left). After nonoperative treatment almost normal spinal canal 17 months later (right).

Table 1. Observations in 14 operated on and 3 nonoperated on patients with thoracolumbar vertebral fractures

Case	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1	F	26	L-5	1, 3, 4	43	0	0	–25	–12	0.15	0.17	1.13	35	20	1	0
2	F	25	L-2	2–4	30	0	9	5	22	0.33	0.35	1.06	20	20	4	0
3	F	18	L-1	0	32	0	0	5	8	0.28	0.39	1.39	20	0	0	0
4	M	19	L-1	2, 3	44	0	0	9	16	0.32	0.48	1.50	20	10	3	0
5	M	20	L-2	2, 3	25	0	0	0	13	0.19	0.24	1.26	45	30	4	3
6	M	30	L-4	1, 3, 4	33	5	10	–13	4	0.17	0.33	1.94	70	10	1	1
7	M	33	L-1	2–4	43	0	0	0	14	0.30	0.30	1.00	30	20	3	3
8	F	52	Th-12	2, 3	32	0	4	15	34	0.31	0.36	1.16	20	10	0	0
9	F	38	Th-12	2, 3	42	0	0	11	16	0.41	0.43	1.05	20	10	0	0
10	M	40	L-2	0	24	5	14	–10	10	0.26	0.28	1.08	20	20	0	0
11	M	41	Th-12	2, 3	43	0	0	1	11	0.30	0.29	0.97	10	10	4	4
12	F	21	Th-12	0	17	0	0	16	28	0.30	0.37	1.23	40	10	0	0
13	F	58	Th-12	2, 3	13	0	0	8	21	0.23	0.24	1.04	15	15	0	0
14	F	27	L-4	2–4	25	9	11	5	13	0.17	0.28	1.65	50	20	2	0
15	F	30	Th-12	2, 3	12	0	7	12	30	0.45	0.46	1.02	15	15	4	3
16	F	29	L-3	2–4	37	0	0	2	11	0.17	0.24	1.41	45	20	0	0
17	M	25	Th-12	2–4	14	0	0	13	10	0.45	0.54	1.20	10	0	4	4

A Sex
B Age at fracture
C Level of fracture
D Operation
  1 Hartshill's rectangle
  2 Harrington's rod
  3 fusion
  4 partial laminectomy
E Months between the first and the follow-up examination
F Cobb's angle at the first examination
G Cobb's angle at the follow-up examination
H Kyphosis at the first examination
I Kyphosis at the follow-up examination
J Ratio between the sagittal diameters of the spinal canal and the vertebral body at the first examination
K Ratio between the sagittal diameters of the spinal canal and the vertebral body at the follow-up examination
L Ratio between K and J
M Visually estimated reduction of the spinal canal area as a percentage at the first examination
N Visually estimated reduction of the spinal canal area as a percentage at the follow-up examination
O Neurologic deficits at the first examination
P Neurologic deficits at the follow-up examination
  0 normal function
  1 L-5
  2 S-1
  3 sacral
  4 paraplegia

There were seven Th-12 fractures and 10 lumbar fractures. Three patients had a stable fracture without a risk of acute dislocation and without any neurologic symptoms. These fractures were treated nonoperatively with a rigid thoracolumbar orthosis. Ten patients with neurologic deficits and 4 without neurologic symptoms had an unstable fracture and/or a major intraspinal bone fragment. These fractures were reduced and stabilized with Harrington's distraction rods (n 12) or with a Hartshill rectangle (n 2), including posterolateral fusion to the segments above and below the fracture level. A partial laminectomy was performed in 7 patients. Postoperatively, a rigid thoracolumbar orthosis was used. The Harrington rods were removed at least 4 months before the follow-up examination; on the other hand, the Hartshill rectangles were not removed.

All the fractures were studied with 5-mm consecutive CT scans and conventional radiographs with anteroposterior and lateral views: viz., the 3 nonoperated on fractures in conjunction with the trauma and at the follow-up 17–32 months later, and the 14 operated on fractures immediately after surgery and at the follow-up 31 (12–44) months later.

Results

Intraspinal bone fragment evaluated by CT

The mean ratio between the sagittal diameters of the spinal canal and the vertebral body (S/B) was 0.28 (0.15–0.45) at the first examination and 0.34 (0.17–0.54) at the follow-up examination (Table 1). In all the patients the ratio, i.e., the relative sagittal diameter of the spinal canal, was unchanged or larger at the follow-up examination. The visually estimated mean reduction of the spinal canal area was 29 (10–70) percent at the first examination and 14 (0–30) percent at the follow-up examination. Narrowing of the spinal canal between the two examinations did not occur. The restitution of the spinal canal did not differ in the operated and nonoperated on patients.

At the first examination, 3 patients had a Cobb angle between 5° and 9°, whereas the remaining 14 patients had no lateral deviation (Table 1). At the follow-up examination, 6 patients had a Cobb angle between 4° and 14°, and the remaining 11 patients had a Cobb angle of 0°. The largest lateral deviation was seen in a nonoperated on patient (Case 10). The other 2 nonoperated on patients had no lateral deviation.

Plain radiography

The kyphosis measured –25° to +16° (mean +3°) at the first examination and –12° to +34° (mean +15°) at the follow-up examination. The progression of the kyphosis did not differ in the operated and nonoperated on patients.

Clinical symptoms

All but 4 patients had some intermittent aching and/or stiffness at the fracture level at the follow-up examination. Neurologic deficits noted at the initial examination had disappeared at the follow-up examination in 3 patients with a fracture below the conus medullaris (L-1) and in 1 patient with an L-1 fracture (Table 1). No recovery or partial recovery of the initial neurologic deficits was recorded in 2 patients with a fracture below the conus medullaris and in 4 patients with an L-1 or Th-12 fracture. There was no correlation between the extent of the neurologic deficits and the degree of the residual spinal canal reduction.

Discussion

In the present study of thoracolumbar vertebral fractures, the definition of the posterior margin of the spinal canal at CT was difficult in some cases due to laminectomy or interference from the Harrington rods. In most cases, however, the measurement of the sagittal diameter of the spinal canal and the visual estimation of the spinal canal area correlated well.

Operative treatment, including osteosynthetic stabilization, is a rational way of combining an adequate treatment of a spinal fracture with instability and/or neurologic injury with early mobilization of the patient (Willén et al. 1985). In this case, the risk of local and general complications due to the surgery can be accepted. This risk should be less acceptable if surgery is performed to prevent a presumed, but uncertain, risk of future symptomatic spinal defects in a stable vertebral fracture without neurologic symptoms.

A bone fragment in the spinal canal can cause acute neurologic injury depending on the fracture level, as well as on the size and the location of the fragment. The spinal cord is more sensitive to trauma than the lumbar nerve roots. The degree of displacement of the fragment might have been more pronounced at the time of injury than what is seen at a CT examination. This is the probable explanation of the lack of correlation between the degree of residual spinal canal reduction and the extent of neurologic deficits in our study. The fragment can also be asymptomatic, although it has been suggested that a major fragment might cause subsequent symptomatic neural compression (Bohlman 1985). However, our findings suggest that this risk is negligible after a thoracolumbar fracture because of remodeling of the spinal canal, which has been indicated in earlier studies (Krompinger et al. 1986, Fidler 1988).

The combination of posttraumatic remodeling of the spinal canal and of a risk of complications due to surgery is a strong argument that a patient with a stable thoracolumbar fracture and an intraspinal bone fragment, but without neurologic symptoms, need not, irrespective of the size of the fragment, be operated on.

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