External fixation test in low back pain

Function analyzed in 25 patients

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We recorded the musculoskeletal performance capacity of 25 patients suffering from chronic severe low back pain before and during the external fixation test of the lumbar spine. The capacity was measured by isometric and isokinetic lifting, repetitive upper extremity lifting with a load, repetitive squatting, and the walking distance. Only walking distance was increased by fixation of the spine.

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The external transpedicular fixation of spinal segments was originally introduced for the treatment of fracture dislocations of the thoracolumbar spine (Magerl 1982). External fixation has been used also to test painful conditions of the spine, such as degenerative disc disease and spondylolisthesis (Olerud et al. 1986, Jeanneret and Magerl 1991). The external fixation test has been shown to have predictive value for subsequent solid spinal fusion (Esses et al. 1989, North et al. 1990, Soini et al. 1993). Little is known about the mechanism of pain relief. In many cases the pain relief may be due to the increased stability of the involved segments (Olerud et al. 1986).

The effect of external fixation on the musculoskeletal performance has not been reported earlier. We measured several musculoskeletal functions before and during external fixation of the spine in patients with low back pain.

Subjects and methods

Our prospective series in 1990–1991 comprised 30 consecutive patients with severe chronic low back pain and suspected, but radiographically not verified, instability (Table 1). No patients with definite translational instability were included in this study (Table 1). The etiology of the suspected instability was considered to be disc degeneration in 14 cases (all verified by discograms), repeated previous spinal surgery in 10, degenerative spondylolisthesis in 4 and lytic in 2 cases. To exclude conditions with encroachment of the spinal canal, such as herniated discs and spinal stenosis, a water-soluble myelogram and subsequent CT were carried out in each case. Lumbar mobility was measured using extension-flexion radiographs, according to Putto and Tallroth (1989). Flexion-extension angular motion was measured using the method of Begg and Falconer (1949). Translational movement was measured by calculating the position of the posterior inferior lip of the superior vertebral body in relation to the upper endplate of the inferior vertebral body. The criteria for instability at L1–L5 was a translational motion > 3 mm and for L5–S1 was > 4 mm according to Nachemson (1981). The angular movement, however, according to some recent publications (Dvorak et al. 1991, Soini et al. 1991, Tallroth et al. 1992) was judged to be abnormal, when it was > 15 degrees at L1–L5 or > 20 degrees at the L5–S1 level.

The mean age of the patients was 43 (27–53) years. The patients reported a long history of pain. The mean duration of low back pain was 57 (6–144) months and that of leg pain 41 (6–144) months. The Oswestry disability index was, on average, 48 (22–64), indicating severe disability (Fairbank et al. 1980). 18 of the patients had undergone previous decompressive surgery.

The tested spinal segments were chosen on the basis of clinical and radiographic (myelogram, CT, discogram, extension-flexion pictures) findings. The most frequently tested segments were L4–S1 and L4–5. Schanz screws were inserted through small skin incisions. An imaging intensifier was used to control the position of the screws in the AP and lateral views. The AO external fixator (Magerl 1982, Schläpfer et al. 1982) was installed for the fixation test. The distraction of the involved segment or segments was performed already on the operating table respecting the lumbar lordosis. The patients were mobilized on the first postoperative day after radiographic control.

Table 1. Main characteristics and clinical observations in 30 tested patients

A	B	C	D	E	F	G	H	I	J	K	L
1	M	33	34	38	2	–	H	2	–	+	–
2	F	27	24	56	2	–	G	1	–	+	–
3	F	41	48	54	1	–	H	2	–	+	–
4	F	44	120	42	3	–	–	4	–	+	–
5	F	52	120	22	4	–	Sx2	2	–	+	–
6	F	36	120	44	3	–	–	2	–	+	–
7	F	47	13	60	3	–	–	1	–	+	–
8	F	49	12	53	4	–	Hx2	2	+	+	–
9	M	38	62	66	4	–	Hx2	1	–	–	+
10	F	31	48	38	4	–	Hx3	4	–	+	–
11	M	49	120	44	4	–	Hx2	2	–	+	–
12	F	48	30	60	4	–	Hx2	1	–	+	–
13	F	48	48	58	1	+	Sx1	4	+	+	–
14	M	44	24	44	4	–	Hx4	2	+	+	–
15	M	53	50	36	3	–	Hx1	5	–	–	+
16	F	35	48	64	4	–	Hx3	2	+	+	–
17	F	40	106	48	3	+	–	2	–	+	–
18	F	50	36	60	3	–	–	4	–	+	–
19	F	43	24	40	3	–	–	1	+	–	+
20	M	44	18	64	3	–	–	2	–	+	–
21	F	48	140	34	3	–	Hx1	2	–	–	+
22	F	37	96	50	1	–	–	4	–	+	–
23	M	44	24	24	3	–	Hx1	2	–	+	–
24	F	52	6	44	3	–	–	2	–	+	–
25	M	38	14	44	3	–	–	2	–	+	–
26	F	44	20	52	1	–	–	2	–	+	–
27	F	45	48	60	3	–	Hx1	5	–	+	–
28	M	45	100	42	4	–	Hx2	4	–	+	–
29	F	43	144	28	4	–	Hx2	2	–	+	–
30	F	35	120	48	3	–	–	4	–	–	+

A Case
B Sex
C Age
D Duration of low back pain in months
E Oswestry disability index in percent
F Test indication
  1 degenerative
  2 lytic spondylolisthesis
  3 disc degeneration with LBP
  4 multi-operated back patients
G Abnormal angulatory movement
  + > 15° at L1–L5 or
    > 20° at L5–S1
H Previous spinal operations
  H operation for herniated disc
  G Gill's procedure for spondylolisthesis
  S decompression for spinal stenosis
I Tested spinal segments
  1 L5–S1
  2 L4–S1
  3 L3–S1
  4 L4–L5
  5 L3–L5
J Complications
K Test response subjectively
  + benefit
  – no benefit
L Drop-out

They were encouraged to perform daily activities that usually had caused them pain. The magnitude of the distraction force was adjusted, if necessary, during the next few days to provide maximum comfort. The mean duration of the fixation test was 22 (15–34) days.

5 of the 30 patients subjectively experienced no benefit from the fixation, or the symptoms became even worse during the test. In these cases the external frame was removed and the measurement of musculoskeletal functions could not be done with the installed device. These patients were thus excluded from the study. This group did not differ from the main study group as to anamnestic, clinical or radiographic parameters. The final study group consisted of 25 patients (18 women, 7 men). All 25 patients underwent anterior interbody fusions.

The following physical parameters were performed before the external fixation test and at the end of the test period:

Isometric lifting. The subject was standing, with the trunk in a slightly forward bent position, arms in front of the thighs. The subject gripped the handle of the isometric strain dynamometer with his/her hands. The subjects did 2 maximal lifts after submaximal training. The better value of the maximal efforts was registered. The lifting strength was related to body weight (Alaranta et al. 1990).

Table 2. Musculoskeletal functions measured without and with external fixation (EF). Median (range)

	Without EF	With EF	*P*-value
Isometric lifting (kp/kg)	123 (25–205)	136 (27–235)	0.1
Isokinetic lifting 50 cm/sec (kp/kg)	65 (17–152)	72 (27–155)	0.3
Isokinetic lifting 100 cm/sec (kp/kg)	40 (8–105)	50 (13–117)	0.2
Repetitive upper extremity lifting with load (rep)	19 (1–35)	20 (7–47)	0.7
Repetitive squatting (rep)	11 (0–31)	13 (0–30)	1.0
Walking distance (km)	0.4 (0.03–1.5)	1.2 (0.2–1.5)	0.001

Isokinetic lifting. The device used was Ariel 4000. The subjects practised the isokinetic lifting a few times submaximally with velocities of 50 and 100 cm/s. Maximal efforts were then made with both velocities. The peak torque values related to body weight were registered (Jacobs and Pope 1986).

Repetitive upper extremity lifting with a load (men 10 kg, women 5 kg). The maximum repetitions with the dominant hand were registered (Alaranta et al. 1990).

Repetitive squatting. The maximum repetitions of squatting were registered (Alaranta et al. 1990).

Walking test. A treadmill test was performed at a speed of 3 km/h. The patients were requested to walk until their legs or back became so tired, numb or painful that they could not continue walking. The maximum test distance was 1.5 km (Eskola et al. 1992).

The study design was approved by the Ethics Commitee of the hospital, and the informed consent of all subjects was obtained.

Differences between the measurements were analyzed with the Wilcoxon signed rank sum test.

Results

The median values of the tested parameters did not decrease (Table 2). A marked increase in the walking distance was found (P 0.001); 9/11 subjects having initial values below 300 m were able to walk more than 900 m with external fixation.

5 patients out of 30 had a pin tract infection (2 definite, 3 probable) as a complication of the fixation. The infections were overcome with antibiotic treatment, and the second measurement of musculoskeletal functions could be carried out in 4 patients, who subjectively benefited from the fixation. 1 patient had pin tract infection and experienced no benefit from the test. The external frame was subsequently removed. No complications due to the measurement procedure itself were recorded.

Discussion

In recent years, both physical and emotional function of patients with low back pain have been subjected to assessment in a standardized manner (Kishino et al. 1985, Mayer et al. 1985, Rothstein et al. 1987, Deyo 1988, Nykvist et al. 1990, Dvir 1991, Hazard 1991). Our results demonstrate that the lumbar external fixation test improved significantly only the walking distance, although all the median values of the tested functions increased. On the basis of this study, it is not possible to draw any conclusions as to why walking capacity was the only performance that significantly improved. One could speculate that walking is a familiar everyday activity without sudden peak loading, in contrast to the other measured functions. Mild local pain in the region of the external fixation during the lifting test was reported by most test participants. The apprehension that forced lifting might increase pain could be one explanation.

The external fixation test of the lumbar spine is a procedure associated with numerous complications (Soini and Seitsalo 1993). In 30 patients, 5 infections were recorded, one resulting in device removal. In this series no complications arose from the musculoskeletal performance tests. It seems reasonable, however, to refrain from using too stressful tests with dynamometers, in order to avoid possible spinal complications, especially, because these tests gave no more significant information. The measurement of the walking distance seems to be of value, and may help to determine the positive outcome of the external fixation test, in addition to the patient's subjective reaction.

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