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Conservative treatment of fractures of the thoracolumbar spine

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Abstract We reviewed 48 patients with thoracolumbar fractures treated conservatively between 1988 and 1999. The average follow-up was 77.5 (31–137) months and average patient age (23 women, 25 men) was 46 (18–76) years. Twenty-nine patients suffered a fall from a height and 13 patients were injured in traffic accidents. Thirty-two patients had compression-type fractures and 16 burst-type fractures. There were no neurological deficits. Twenty-nine patients were treated by orthosis, 13 by body cast and six by bed rest. In addition to pain and functional scoring, we measured a number of radiographic parameters at the time of admission and at latest follow-up and compared the values. In patients with compression fractures there were significant changes in scoliosis angle and wedging index ($p<0.05$). The mean pain score was 1.66 and mean functional score 1.03. In patients with burst fractures, vertebral index, wedging index and height loss increased after treatment ($p<0.05$). The mean pain score was 1.26 and functional score 0.93. Compression fractures with kyphosis angle $<30^\circ$ are supposed to be stable and can be treated conservatively. If the kyphosis angle is more than 30° , magnetic resonance imaging (MRI) should be performed, and if the posterior ligamentous complex is damaged, surgery should be considered. In burst fractures, MRI should always be performed and conservative treatment should only be considered if there is no neurological deficit and the ligaments are intact.

Résumé Nous avons examiné 48 malades avec une fracture dorsolombaire traitée d'une manière conservatrice entre 1988 et 1999. Le suivi moyen était de 77,5 (31–137) mois et l'âge moyen des malades (23 femmes, 25 hommes) était de 46 (18–76) ans. Vingt-neuf malades avaient fait une chute de grande hauteur et 13 malades ont été blessés dans un accident de la circulation. Trente-deux malades avaient des fractures du type compression et 16 fractures du type explosion. Il n'y avait pas de déficit neurologique. Vingt-neuf malades ont été traités par orthèse, 13 par corset plâtré et six par repos au lit. En plus des scores douleur et des scores fonctionnels, nous avons comparé plusieurs paramètres radiographiques entre l'admission et le plus long recul. Chez les malades avec fracture-compression il y avait des changements significatifs dans l'angle de la scoliose et l'index angulaire ($p<0.05$). Le score moyen de la douleur était 1.66 et le score fonctionnel moyen 1.03. Chez les malades avec fracture-explosion, l'index vertébral, l'index angulaire, et la perte de hauteur ont augmenté après traitement ($p<0.05$). Le score moyen de la douleur était 1.26 et le score fonctionnel 0.93. Les fractures de type de compression avec angle de cyphose $<30^\circ$ sont supposés être stables et sont traités d'une manière conservatrice. Si l'angle de la cyphose est de plus de 30° , une IRM devrait être exécutée et si le complexe ligamentaire postérieur est endommagé, la chirurgie devrait être envisagée. Dans les fractures du type de explosion, une IMR devrait toujours être exécutée et le traitement conservateur devrait être retenu seulement s'il n'y a aucun déficit neurologique et si les ligaments sont intacts.

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Introduction

It is controversial whether surgical or conservative treatment is more effective in the treatment of spinal fractures. It is generally accepted that conservative treatment should be considered for stable fractures and surgical treatment for unstable fractures [2–4, 22]. In this study, we aimed to evaluate the efficacy of nonoperative treatment in compression and burst spinal fractures.

Table 1 Patient data. *F* Female, *M* male, *C* compression, *B* burst, *MVA* motor vehicle accident, *FFH* fall from height, *SF* simple fall, *DT* direct trauma, *FU* follow-up period in months, *BT* before treatment, *LFU* latest follow-up, *BC* body cast, *BR* bed rest, *HL* height loss in percent, *T* treatment, *P* pain, *F* function, *O* orthosis

Gender	Age	Level	Type	Mechanism	FU	Kyphosis angle		Scoliosis angle		Vertebral index		Wedging index		HL (%)		T	P	F
						BT	LFU	BT	LFU	BT	LFU	BT	LFU	BT	LFU			
M	52	L1	C	MVA	178	18	20	5	6	16	19	17	21	23	26	BC	2	1
F	25	L1-2	C	FFH	175	14	10	3	9	15	11	16	20	25	26	BR	1	0
F	54	L2	B	FFH	144	28	12	7	4	25	20	22	19	33	27	BC+O	1	1
M	62	L1	C	FFH	141	18	24	4	5	20	25	19	23	25	27	O	2	1
F	54	L1	C	FFH	137	14	20	2	4	16	21	18	24	21	31	BR	3	1
F	27	L1	B	FFH	134	21	29	6	10	23	30	25	29	25	28	BC	2	2
M	47	T12	B	FFH	125	20	24	3	5	21	27	24	28	22	23	O	2	2
F	52	T12	C	FFH	121	15	19	2	4	18	20	16	19	19	22	O	2	1
F	76	L1	B	FFH	111	14	21	8	10	14	19	15	22	17	28	O	1	1
M	72	T12	C	DT	99	25	20	12	8	16	12	23	21	31	11	BR	3	1
M	27	L5	C	FFH	98	12	15	3	4	13	16	14	15	10	53	O	2	1
F	52	T12	C	FFH	96	12	30	5	5	18	22	10	18	27	17	BC+O	3	3
M	40	L2	B	FFH	87	16	15	2	2	14	12	15	14	18	23	BC+O	2	0
F	62	L1	C	FFH	86	18	20	3	5	20	22	17	21	22	24	O	1	1
F	53	L1-2	C	FFH	85	16	18	5	6	15	19	17	23	20	28	O	2	1
M	52	L1	B	MVA	84	24	33	4	7	26	31	28	33	25	17	BR+O	0	0
F	24	L1-2	C	MVA	83	12	15	2	3	14	18	13	14	15	18	O	3	2
M	70	T12	C	FFH	82	15	17	6	8	16	19	14	18	16	29	BR	1	1
F	63	L1	C	MVA	80	27	31	4	5	25	28	24	30	25	35	O	1	0
F	70	T12	B	FFH	79	22	30	4	8	24	32	20	27	25	12	O	1	0
M	47	L1	C	FFH	77	15	14	6	4	16	11	17	15	16	15	BC	0	1
M	29	T5-8	C	FFH	76	14	16	3	4	15	17	16	18	12	14	BC+O	1	0
M	36	T12	C	FFH	76	20	17	2	3	21	15	22	19	16	20	BC+O	1	1
M	43	L2	C	SF	75	5	2	4	3	11	5	8	6	26	10	O	1	0
M	45	L2-3	C	MVA	74	14	12	2	3	15	12	13	11	12	20	BC	1	3
M	36	T12	C	MVA	74	12	15	4	6	14	18	14	17	19	29	O	2	1
F	51	L3	B	MVA	73	18	24	3	6	17	24	16	25	25	25	O	0	1
F	69	T11-12	C	FFH	60	18	15	10	7	16	8	17	15	29	20	BR	4	2
M	45	T9	C	FFH	59	17	18	5	6	18	20	14	17	18	29	O	1	1
F	72	T12	C	FFH	58	21	32	8	11	25	30	23	29	22	23	O	2	2
F	62	T11	C	SF	57	20	24	5	9	21	23	24	28	20	27	BR+O	3	1
F	67	T12	B	MVA	56	22	25	4	5	24	26	20	22	24	12	BR+O	1	0
M	30	T12	C	MVA	56	15	12	2	3	14	10	12	11	15	17	O	2	1
M	68	L1-3	C	FFH	55	27	23	4	4	25	22	24	23	19	11	O	1	1
M	18	L5	B	FFH	50	14	15	2	2	12	14	13	15	10	35	BC	0	0
F	69	T12	C	FFH	48	8	15	3	3	10	17	13	15	20	22	O	1	1
F	33	L1	B	FFH	47	28	24	10	8	27	25	23	22	24	12	O	1	0
M	29	T11-12	C	FFH	46	11	14	2	2	12	17	14	15	12	26	O	2	1
M	46	L2	B	MVA	45	20	27	7	10	18	24	22	29	23	11	BC	2	2
F	35	L1	C	FFH	43	12	10	2	2	14	11	15	12	12	15	BR+O	1	1
M	48	L2	C	SF	42	15	12	4	3	16	13	15	14	16	16	BR+O	1	1
M	42	L1	B	FFH	41	20	17	5	5	21	18	19	16	15	23	O	2	0
M	32	L3-4	B	SF	40	21	24	8	11	22	26	24	28	19	12	BC+O	2	2
F	29	L1-2	C	MVA	35	15	12	5	4	15	13	17	14	14	21	O	1	0
M	38	L1	B	SF	34	16	22	4	7	18	25	17	23	18	13	O	2	2
F	21	L4	C	FFH	33	14	12	3	2	16	13	15	12	15	21	BR	1	1
F	35	T12-L2	C	MVA	33	16	18	4	9	17	20	18	22	19	24	BC	1	1
M	38	T12	B	MVA	31	20	24	6	10	21	25	22	27	20	25	O	2	1

Table 2 Comparison of radiological parameters at initial diagnosis and at latest follow-up. *M* Mean, *SD* standard deviation, *SE* standard error, *BT* before treatment, *LFU* last follow-up, *ns* non-significant

	Kyphosis angle		Scoliosis angle		Vertebral index		Wedging index		Height loss	
	BT	LFU	BT	LFU	BT	LFU	BT	LFU	BT	LFU
For patients with compression fractures										
M	15.8	17.2	4.2	4.9	16.6	16.9	16.5	18.0	19.0	21.0
SD	4.71	6.27	2.31	2.38	3.70	5.68	3.99	5.45	5.29	8.92
SE	0.82	1.09	0.40	0.41	0.60	0.99	0.69	0.95	0.92	1.55
<i>p</i> Value	ns		<0.05		ns		<0.05		ns	
For patients with burst fractures										
M	19.9	23.4	5.4	7.2	20.9	24.4	20.7	24.3	21.6	24.5
SD	4.67	5.56	2.26	2.68	4.34	4.95	4.10	5.09	5.50	5.88
SE	1.21	1.44	0.59	0.69	1.12	1.28	1.06	1.31	1.42	1.52
<i>p</i> value	ns		<0.05		<0.05		<0.05		<0.05	

Patients and methods

Between 1988 and 1999, 48 patients with thoracolumbar spinal fractures were treated conservatively. There were 25 men and 23 women. Average age was 46 (18–76) years and average follow-up was 77 (31–137) months. The fracture was caused by a fall from a height in 29 patients, by motor vehicle accidents in 13 and by a simple fall in five. One patient suffered a direct blunt trauma.

The fractures were classified according to Denis [7, 9]. There were 32 patients with compression fractures and 16 with burst fractures. Compression fractures were type A in six patients, type B in 13, type C in eight, and type D in five. Five burst fractures were type A, nine type B, one type C and one type D. Three quarters of the fractures involved only a single level and, except for one patient, all multilevel fractures were of the compression type. More than half (34 of 64) of the spinal fractures were located in Th 12 or L1 levels and three quarters were in Th11–L2 levels (thoracolumbar junction). None of the patients had any neurological deficit at the time of diagnosis.

Conservative treatment consisted of a thoracolumbosacral orthosis (TLSO) in 29 patients, body cast in seven, body cast followed by TLSO in six and bed rest of 3 months in six. Patients treated with bed rest all had compression-type spinal fractures and associated fractures (calcaneus, pelvis) in other parts of the body dictating the delay in ambulation. In compression fractures, TLSO or body cast was used for 3–6 months with early ambulation. In burst fractures, TLSO or body cast was used for up to eight, and ambulation was not started until after 3–4 weeks.

In all patients, plain radiographs and computed tomography (CT) scans were taken at regular intervals. From radiographs taken at initial diagnosis and last follow-up, kyphosis angle, scoliosis angle, wedging index, vertebral index and loss of height were measured and compared with each other. Pain and functional status at latest follow-up were evaluated using the scale (0–5) described by Denis [8]. The paired *t* test was used for statistical analysis. A *p* value of less than 0.05 was considered as statistically significant.

Results

Age, fracture level, fracture type, trauma mechanism, follow-up period, kyphosis angle, scoliosis angle, vertebral index, wedging index, height loss percentages on admission and at latest follow-up with results of pain and functional evaluation are all shown in Table 1.

For patients with compression fractures, the mean pain score was 1.66 and the mean functional score was 1.03. The changes in scoliosis angle and wedging index from admission to latest follow-up differed statistically ($p < 0.05$) whereas there were no significant changes in kyphosis angle, vertebral index, and height-loss percentages ($p > 0.05$). In patients with burst fractures, the mean pain and functional scores were 1.26 and 0.93, respectively. The changes from admission to latest follow-up in scoliosis angle, vertebral index, height loss percentages and wedging index was significant ($p < 0.05$) whereas the changes in kyphosis angle was without significance. During treatment, we saw two patients treated with body cast complaining of sweating and three patients treated with TLSO with skin problems. We saw no other complications (Table 2).

Discussion

Stability is the major factor when selecting treatment for thoracolumbar spinal fractures. Until recent years, the “three column theory” described by Denis [7] in 1983 was the most accepted concept. Denis described instability as mechanical instability (first degree), neurological instability (second degree), and combined mechanical and neurological instability (third degree). He stated that the involvement of the middle column was a sufficient criterion for instability without any relation to type or direction of forces acting on the spinal column [7, 9]. MRI has brought out a new dimension in the stability concept and leads us to consider the importance of the posterior ligamentous complex. It is advocated that evaluation of the posterior ligamentous complex on MRI is essential before a decision of instability is made. Compression fractures or burst fractures with middle-column involvement can be described as

unstable if there is associated posterior ligamentous complex injury proven by MRI [1, 18, 20].

The most common fracture type in our patients was compression fracture. Compression fractures are stable fractures produced by hyperflexion forces. The injury is only localized in the anterior portion of the vertebral body [7, 9]. It was reported that posterior ligamentous complex injury was seen in fractures with kyphosis angle more than 30° and anterior height loss more than 40%. Surgical treatment was advocated for these types of fractures [13]. In our study, the kyphosis angle was less than 30° in all patients. During the follow-up period, the kyphosis angle was measured as 31°, 32°, and 33°, respectively, in two patients with compression fracture and one patient with burst fracture. Pain and functional evaluation scores were measured as mildly high in these patients. In the multicenter study of 1,019 cases by Gertzbein [11], it was reported that patients with kyphosis angle more than 30° presented with significant back and low-back pain in their 2-year follow-up periods.

One third of the fractures in our series were burst-type fractures. Various studies in the literature have dealt with the issue of radiological analysis of stability in burst fractures. Krompinger et al. [16] accepted burst fractures as stable if the kyphosis angle was less than 25° and spinal canal narrowing was less than 50%. In the study of Reid et al. [19], fractures with kyphosis less than 35° and anterior height loss less than 60% were accepted as stable. Contor et al. [4] stated that fractures without neurological deficit, with kyphosis less than 30° and height loss less than 50% were defined as stable. On the other hand, Denis [9] described all burst fractures as unstable and advocated surgical treatment in all. Krompinger et al. [16] reported the criteria for surgical treatment as a neurological deficit (except single nerve root involvement), translation, flexion-rotation and distraction fractures with more than 30° kyphosis.

Knight et al. [15] found the indications for conservative treatment as absence of neurological deficit, anterior height loss less than 20%, kyphosis less than 20°, spinal canal narrowing less than 20%, single-level fractures and associated multiple fractures. Willen et al. [23] reported that satisfactory results were obtained with conservative treatment in types A and B compression fractures. On the other hand they advocated surgical treatment in fractures with more than 50% anterior height loss, spinal canal narrowing and rotational instability at the fracture level. Domenicucci et al. [10] reported similar results in patients with fractures less than 20° kyphosis as a result of conservative or surgical treatment. Today, the most important anatomical structures playing a significant role in stability are known as ligamentum flavum, interspinous, and supraspinous ligaments (posterior ligamentous complex). The correct evaluation of these structures can be made with the help of MRI [1, 18, 20].

In the patients with burst fractures in our study, the greatest kyphosis angle was 28° and anterior height loss was 31%. CT was performed in all patients and the burst fractures (anterior and middle-column involvement) with

kyphosis angle less than 20° and anterior height loss less than 20% were accepted as stable fractures and treated conservatively. MRI was done to evaluate the posterior ligamentous complex in patients with fractures involving three columns, kyphosis angle more than 20°, and anterior height loss more than 20%. There was no neurological deficit in our study group.

A statistically significant difference between pretreatment and latest follow-up values was seen for scoliosis angle, wedging index, vertebral index and height loss in patients with burst fractures. On the other hand, there was no significant difference regarding kyphosis angle. These results showed that deformity increased radiologically during the conservative treatment period. In contrast, pain and functional scores were not related to the radiological increase in deformity. Most patients could return to their daily activities and previous jobs with minimal pain and functional loss. It is generally accepted that radiological and functional results of conservative treatment do not correlate with each other [17, 25]. Hazel et al. [13] could not find any relation between severity of the initial injury and radiological development of degenerative changes with clinical complaints. Also, Young [25] did not report any relation between symptoms and severity of fracture, deformity produced, or any other radiological changes found in 116 patients with compression fractures treated conservatively. Mumford et al. [17] reported 2-year follow-up results of 41 patients with burst fractures treated initially by 30-day bed rest and later mobilization with TLSO. They detected 66% good–very good clinical results and 90% of the patients could return to their previous jobs. They could not find any relation between initial injury severity and post-treatment deformity. Contor et al. [4] studied 18 patients with stable burst fractures in the thoracolumbar junction. They were treated by orthosis and early ambulation. Fifteen of 18 patients were able to return to their previous daily activities without or with only minimal pain. Weinstein et al. [22], in their study of 52 thoracolumbar burst fractures treated conservatively, reported that there were no increases in neurological status of the patients, 88% of whom were able to return to their previous jobs. They found a kyphosis angle of 26.4° at the end of treatment and could not find any relation between kyphosis degree and pain or functional scores.

It is generally known that fracture fragments invading the spinal canal in burst fractures undergo a remodelling during the course of conservative or surgical treatment [5, 14, 21, 24]. In some studies, it has been reported that 50% of retropulsed fracture fragments in the thoracolumbar region are reabsorbed [6, 12]. A spinal invasion of 35% at Th10–12 levels, 45% at L1, and 55% at L2 level can be tolerated without any neurological deficit [12]. For this reason, the presence of retropulsed bony fragments in the spinal canal without associated neurological deficit is not an indication for surgical treatment.

Several complications, such as thromboembolic events, decubitus, cast syndrome and urinary infection, has been reported to occur during the course of conservative treatment of spinal fractures [7, 16, 17]. We saw no such

complications in our patients and regard regular and careful follow-up as essential to reduce such complications.

In conclusion, compression-type vertebral fractures with kyphosis of less than 30° are stable and good candidates for conservative treatment. In fractures with kyphosis of more than 30°, MRI should be considered to evaluate the posterior ligamentous complex and if it is injured, surgical treatment should be undertaken. MRI is especially important for the evaluation of burst fractures. In burst fractures without any neurological deficit and without any injury to the posterior ligamentous complex, conservative treatment should be the first choice.

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