

## load-sharing

### Decision of Posterior Fixation Level by Load-Sharing Classification in Thoracolumbar and Lumbar Burst Fracture

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#### – Abstract –

**Study Design :** Retrospective study on 54 thoracolumbar and lumbar burst fractures treated with pedicle screw instrumentation.

**Objectives :** To decide the optimal level of fusion in thoracolumbar and lumbar burst fractures treated with pedicle screw instrumentation by load sharing concept.

**Summary of Literature Review :** Short segment pedicle screw fixation is condemned with frequent failure in maintenance of reduction. The type of posterior fixation construct that is most desirable is less well defined.

**Materials and Methods :** Using the Load-Sharing classification, Group I consisted of 24 cases with fractures totaling 6 points or less underwent surgery which was subdivided into two subgroups(A : 1 level above and below including fractured vertebra, B : long segment fixation). Group II consisted of 30 cases with fractures totaling 7 points or more underwent surgery which was subdivided into three subgroups(C : 1 level above and below including fractured vertebra, D : 2 levels above, 1 level below including fractured vertebra, E : 2 levels above and below the fractured vertebra). Change of segmental kyphosis, inter-screw angle, upper disc height, lower disc height and anterior body height were measured using post-operative and follow-up lateral radiographs.

**Results :** Comparing two subgroups in group I(A Vs. B), group A showed definitely more loss of upper disc height than group B but the others were not significantly different. Comparing three subgroups in group II(C, D, E), group C showed definitely more loss of reduction than two other groups but loss of anterior body height was not significantly different. There were no significant differences between group D and E.

**Conclusions :** For fracture totaling 6 points or less, the long segment fixation(2 level above and 1 level below including fractured vertebra) is a successful method at thoracolumbar junction and short segment fixation to preserve motion segment at lumbar spine. For fracture totaling 7 points or more, short segment fixation is inappropriate and long segment pedicle screw fixation (2 level above and 1 level below including fractured vertebra) could effectively treat burst fractures of thoracolumbar and lumbar spine.

**Key Words :** Thoracolumbar, Lumbar, Burst Fracture, Posterior Fixation and Fusion level

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가 17 (31.5%), 3  
(5.5%) . 1 가 21 (38.9%) 가  
, 12 2 가 10 (18.5%),  
3 가 8 (14.8%), 4 가 4 (7.4%), 11 가  
1 (1.9%) .

가 , 50%  
20 , 50%

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(TLSO)

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가 가

54 load-sharing 6 “I”  
(Table 2), 7 “II” (Table 3)  
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1 A (Fig. 1), ( )  
2 , 1

(scoring)

McCormack <sup>8)</sup> load-sharing (Table

) B

1)

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“II”

C (Fig. 2), 2

load-sharing

D (Fig. 3), 2

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가

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1

가

, 1 가 54 가

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, 16 67 36 , .

12 67 31.6

가 34 (63%), 가 .

**Table 1.** The load shearing classification of spine fractures

Score	Comminution /Involvement (%)	Apposition of fracture fragments (mm)	Deformity correction (degree)
1	< 30(little)	< 1(minimal)	< 3(little)
2	30 to 60(more)	1 to 2(spread)	4 to 9(more)
3	> 60(gross)	> 2(wide)	> 10(most)

**Table 2.** Patients with fracture totaling 6 points or less (Group A, B)

Case	Sex /Age (yrs)	Group	Level of injury	Cause of injury	Load-sharing score	Duration of F/U (mos.)	Loss of kyphotic correction (degree) F/U-Postop.	Loss of interscrew angle(degree) F/U-Postop.	Loss of upper disc height (%) Postop.-F/U	Loss of lower disc height (%) Postop.-F/U	Loss of ant. vertebral height (%) Postop.-F/U
1	M/40	A	L2	Others	5	13	7.4	4.6	13.8	12.2	4
2	F/24	A	L3	Fall	6	21	4	2.7	22.5	13.5	2.1
3	M/44	A	L4	Fall	6	20	8.7	2	39.9	23.8	5.1
4	M/24	A	L3	MVA	5	27	4.8	5.6	24.7	26.9	-2.3
5	M/32	A	L2	Fall	5	29	3	-0.7	28.7	16.3	4
6	M/29	A	L2	Fall	4	32	0.1	5.6	9.2	15.1	2.5
7	F/38	A	L2	MVA	5	38	7	2.8	24.4	10.3	-2.9
8	F/19	A	L1	Fall	6	12	3.9	2.7	10	16.4	11.4
9	M/41	A	L1	Fall	5	15	6.5	7.1	40.3	37.2	3.9
10	M/19	A	L1	Fall	4	17	4.7	0.6	21.5	28.9	7.5
11	F/41	A	L4	Fall	4	53	9.5	4.7	16.5	3.1	8.4
12	M/49	A	L1	Fall	4	52	12.9	3.5	37.5	9.9	7.9
13	M/35	A	L3	Fall	3	48	4.3	-0.3	27.3	9	3.8
14	F/51	A	L2	Fall	5	43	7.3	3.9	14.6	41.9	0.4
15	F/29	A	L2	MVA	4	39	2.6	4	3.2	14.4	0.3
16	M/43	A	L4	MVA	5	38	6.7	5	21.4	16.9	0.6
17	F/19	B	L1	Fall	5	36	5.2	5	8.8	19.4	3.3
18	M/23	B	L1	Others	5	26	6.2	3.9	8.9	21.7	2.6
19	F/30	B	L1	Fall	4	35	5.8	3.3	34.8	8.2	-2.3
20	F/34	B	L1	MVA	5	39	1.7	0.9	10.1	14.6	-2.9
21	F/62	B	T12	MVA	6	22	6.3	5.8	11.4	16.5	2
22	M/52	B	T12	MVA	4	26	4.9	-0.8	4.3	17.9	2.6
23	M/38	B	L1	Others	4	30	6	2	7.1	33.3	-0.6
24	F/48	B	T12	Fall	5	43	3.9	0.7	2.7	12.1	3.3

yrs : years F/U : follow-up mos : months Preop. : preoperation Postop. : postoperation F : female M : male

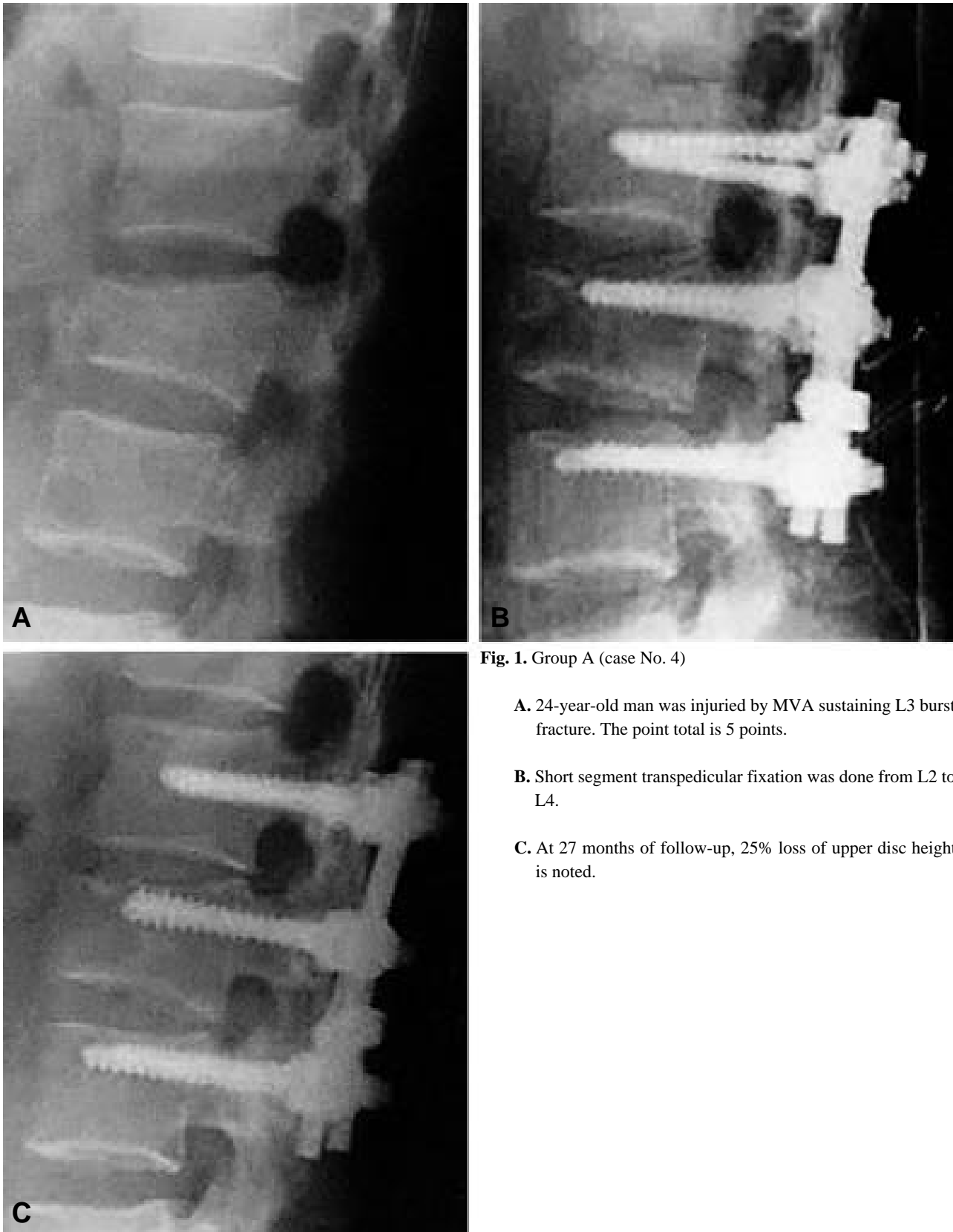
MVA : motor vehicle accident Others : struck by a heavy object

**Table 3.** Patients with fracture totaling 7 points or more (Group C, D, E)

Case	Sex /Age (yrs)	Group	Level of injury	Cause of injury	Load-sharing score	Duration of F/U (mos.)	Loss of kyphotic correction (degree) F/U-Postop.	Loss of interscrew angle(degree) F/U-Postop.	Loss of upper disc height (%) Postop.-Preop.	Loss of lower disc height (%) Postop.-Preop.	Loss of ant. vertebral height (%) Postop.-F/U
25	M/54	C	L2	Fall	8	55	5.2	5.6	35	31.3	-1.5
26	M/31	C	L3	Fall	7	37	17.2	14.9	44.5	42.7	15.4
27	F/54	C	L3	Fall	7	14	5.5	6.7	23.9	24.2	5.6
28	F/40	C	L3	Fall	8	27	7.5	6.8	11.5	22.8	10.7
29	M/16	C	L4	Fall	7	51	14	4.1	25	18.3	9.2
30	M/31	C	L1	Fall	7	14	5.1	7.5	29.7	14.5	2.4
31	M/42	C	L1	Fall	9	15	4.1	8.3	18	28.4	2.4
32	M/33	C	L2	Fall	7	13	8.2	8	30.8	22.9	8.9
33	M/41	C	L1	Fall	7	25	0.3	1.2	7.9	12.8	0.3
34	F/35	C	L3	MVA	8	31	12.7	10	34.8	17.8	8.8
35	M/32	C	L1	Fall	9	36	1.1	4.2	27.4	15.2	10.7
36	F/19	D	L1	Fall	8	13	2.4	0.2	4	9.7	1
37	M/38	D	L2	Fall	7	39	5	5	18.3	18.8	9.2
38	M/24	D	T12	Fall	8	37	1.1	6.5	24.6	14.1	12.2
39	M/42	D	L1	MVA	7	32	3.9	6.9	13.3	2.3	6.5
40	M/37	D	T12	Fall	7	30	2.5	4	18.5	17.9	3.7
41	M/25	D	L2	Fall	7	29	0.3	0.1	14.8	4.1	5.3
42	M/26	D	L3	Fall	8	18	3.2	4.5	16.4	16.1	5.5
43	M/28	D	L1	MVA	7	46	4.4	2.2	12.7	17.1	3.7
44	M/26	E	L1	MVA	8	19	6.5	8.3	31.5	34.2	16.5
45	M/36	E	T12	Fall	8	67	4.9	4.8	17.7	10.6	5.4
46	F/32	E	T12	MVA	8	39	0.9	4.8	11	6.5	5.1
47	F/21	E	L1	MVA	8	38	6.5	3.8	3.8	4.3	11.4
48	F/37	E	L1	MVA	7	35	1.8	1.5	11.5	19.5	4.2
49	F/36	E	L1	Fall	9	31	4.7	0.6	10.9	14.1	6.7
50	M/58	E	T12	MVA	8	13	5.4	3.8	13.6	15.7	3.1
51	M/33	E	T12	Fall	7	45	4.7	2.8	19.5	15.2	1.7
52	F/52	E	L1	MVA	8	29	3.8	2.3	9.6	7.1	7.4
53	F/67	E	T12	Fall	8	25	2.7	3.2	9.3	10.4	13.7
54	M/26	E	T11	MVA	8	49	2.4	3.9	18.7	13.2	4.2

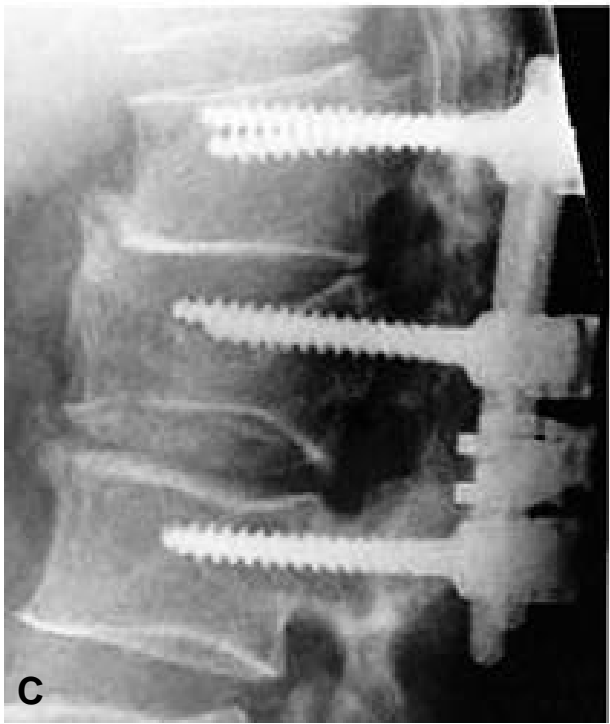
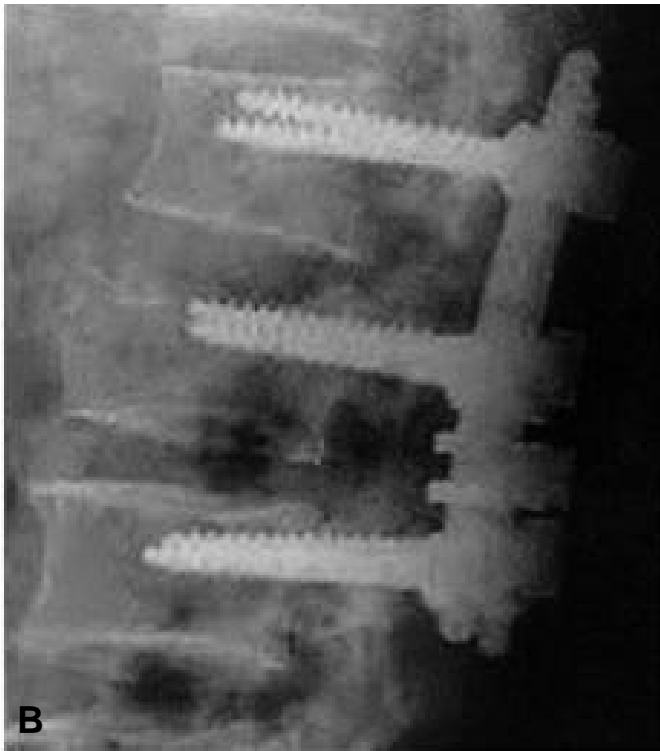
yrs : years F/U : follow-up mos : months Preop. : preoperation Postop. : postoperation F : female M : male

MVA : motor vehicle accident



**Fig. 1.** Group A (case No. 4)

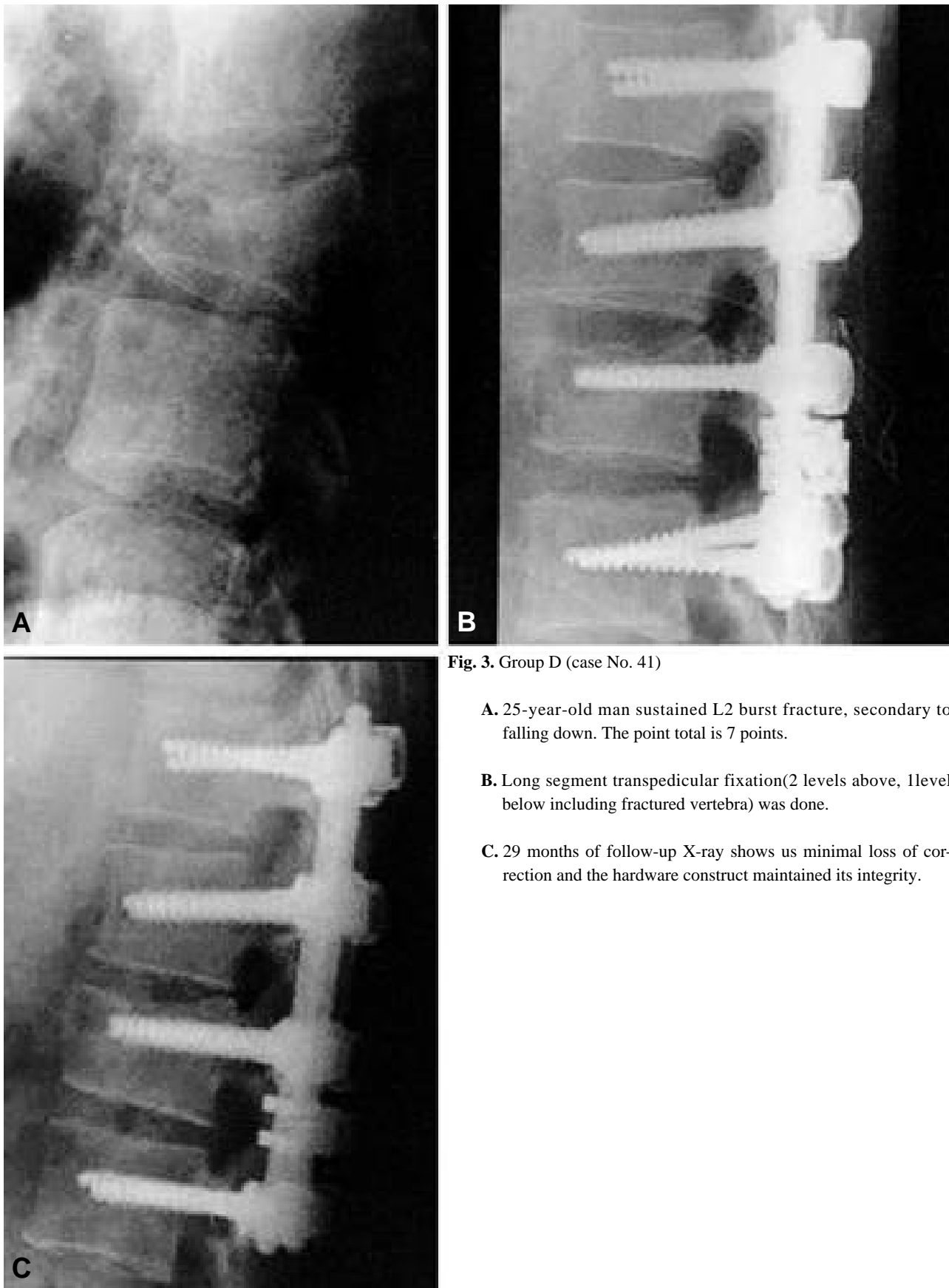
- A.** 24-year-old man was injured by MVA sustaining L3 burst fracture. The point total is 5 points.
- B.** Short segment transpedicular fixation was done from L2 to L4.
- C.** At 27 months of follow-up, 25% loss of upper disc height is noted.



**Fig. 2.** Group C (case No. 32)

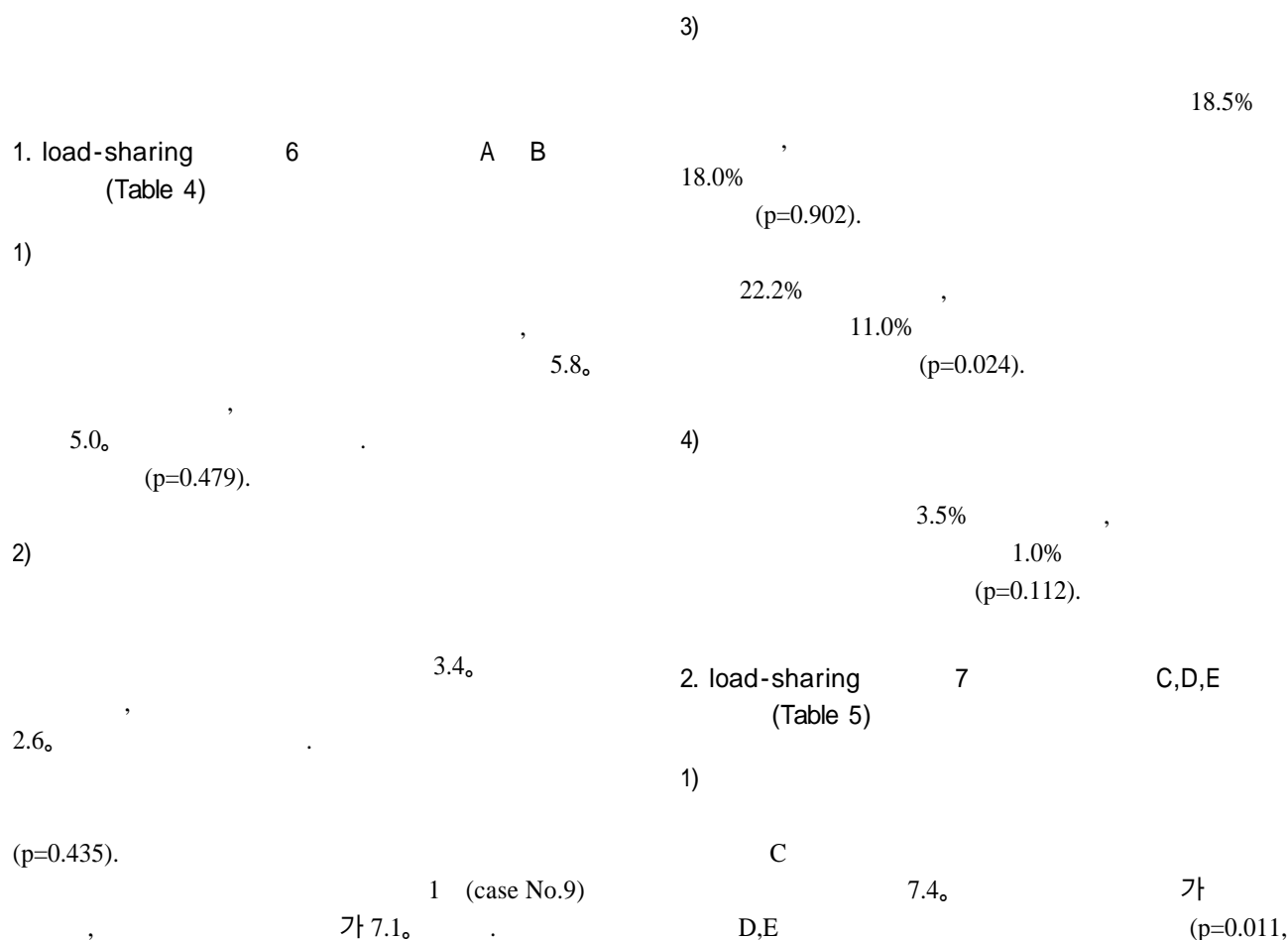
- A.** 33-year-old man sustained L2 burst fracture, secondary to falling down. The point total is 7 points.
- B.** Short segment transpedicular fixation was done from L1 to L3.
- C.** At 13 months of follow-up, marked loss of correction at disc level and kyphotic change of interscrew angle are noted.

가 load-sharing                      6                      (A )                      (B )                      가                      Student t-                      test                      C,D,E                      , load-sharing                      7                      One-way                      ANOVA test                      .



**Fig. 3.** Group D (case No. 41)

- A.** 25-year-old man sustained L2 burst fracture, secondary to falling down. The point total is 7 points.
- B.** Long segment transpedicular fixation(2 levels above, 1level below including fractured vertebra) was done.
- C.** 29 months of follow-up X-ray shows us minimal loss of correction and the hardware construct maintained its integrity.

**Table 4.** Comparison of two groups with fracture totaling 6 points or less

	No. of cases	Loss of segmental kyphosis correction( ° )	Loss of interscrew angle( ° )	Loss of upper disc height(%)	Loss of lower disc height(%)	Loss of anterior vertebral height(%)
A	16	5.84 ± 3.08	3.36 ± 2.18	22.22 ± 10.94	18.49 ± 10.58	3.54 ± 3.92
B	8	5.00 ± 1.55	2.60 ± 2.29	11.01 ± 10.04	17.96 ± 7.51	1.00 ± 2.55
P value		0.479	0.435	0.024*	0.902	0.112

A : 1 level above, 1 level below including fractured vertebra B : long segment fixation

\* : significant differences(p&lt;0.05)

**Table 5.** Comparison of three groups with fracture totaling 7 points or more

	No. of cases	Loss of segmental kyphosis correction( ° )	Loss of interscrew angle( ° )	Loss of upper disc height(%)	Loss of lower disc height(%)	Loss of anterior vertebral height(%)
C	11	7.35 ± 5.32	7.02 ± 3.55	26.22 ± 10.70	22.81 ± 8.79	6.63 ± 5.19
D	8	2.85 ± 1.61*	3.68 ± 2.62*	15.32 ± 5.92*	12.51 ± 6.41*	5.89 ± 3.49
E	11	4.03 ± 1.87*	3.62 ± 2.03*	14.28 ± 7.36*	13.71 ± 8.15*	7.22 ± 4.68

C : 1 level above, 1 level below including fractured vertebra

D : 2 levels above, 1 level below including fractured vertebra

E : 2 levels above and below the fractured vertebra

\* : significant differences(p&lt;0.05)



0.036). D,E (p=0.48). 가 2,7,16,17).

2) 가 15).

가

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7.0. 가 , D,

E (p=0.017, 0.009). 가 가

D, E (p=0.97).

C 5

(case No. 26, 30, 31, 32, 34), E 1 (case No. 44).

, D 5,9,15).

1994 McCormack 8)

3) (load sharing

C capacity) 가가

26.2% 가 D, E 가

15.3%, 14.3% C ,

(p=0.010, 0.003). D,E ,

(p=0.793). C

22.8% ,

가 D,E 12.5%, 13.7%

C (p=0.010,

0.013). D,E (p=0.750). 9 7

4) McLain 9) 2

C 6.6%

D, E 5.9%, 7.2% . C, 19 6 3

D,E .

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. McNamara 10)

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load-sharing

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A B 11.0% 가

22.2% (p=0.024).

Müller <sup>11)</sup> Parker <sup>12)</sup> load-shring 6 가

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2 , 1 7

E 2 , 1

가 ,

D,E C D

E

<sup>1)</sup> Müller <sup>11)</sup> 가가

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