



## Degeneration of non-fused segments after floating lumbar fusion

Alihan DERINCEK, Amir MEHBOD, Manuel PINTO, Ensor TRANSFELDT

*From Twin Cities Spine Center, Minneapolis, USA*

Degeneration of the disc or discs between two fused spinal segments has been termed “floating disc disease”. The purpose of this retrospective study was to show the radiological evolution of the floating disc(s) and the relationship between floating disc degeneration and segmental lordosis, lumbar lordosis and pelvic incidence. Twenty patients, with a mean age of 49.9 years, with symptomatic lumbar degenerative disc disease or low grade spondylolisthesis, who failed non-operative treatment and underwent fusion of 2 or more noncontiguous spinal segments, were included in this study. The radiographs of the floating discs were graded with the modified Gore System. The mean follow-up was 4.2 years. Forty-seven levels were fused and 27 floating discs were studied (13 single, 7 double). Five out of 27 floating discs (18%), in 4 patients, progressively degenerated. None of the floating discs degenerated more than two radiographic grades and none needed additional surgery. Postoperatively, 3 out of 5 degenerated floating discs had decreased segmental lordosis, while the other two had no change; this difference was not significant ( $p = 0.08$ ). Neither was there any significant correlation between floating disc degeneration and lumbar lordosis L1-S1 ( $p > 0.10$ ) or pelvic incidence ( $p > 0.10$ ). This study shows that the effect of floating fusion on floating discs is the same as the effect of a contiguous fusion on adjacent discs.

**Keywords :** floating disc ; disc degeneration.

### INTRODUCTION

For the sake of definition, a normal disc left alone between two surgically fused areas is termed

“floating disc”. Therefore, degeneration of the disc or discs between two non-contiguous fused areas has been termed “floating disc disease”. While adjacent segment degeneration has already been studied, degeneration of floating discs is yet to be explored. This was the purpose of the current study. Moreover, the authors tried to establish an eventual correlation between floating disc degeneration and postoperative segmental lordosis, lumbar lordosis and pelvic incidence.

### MATERIALS AND METHODS

This retrospective study was focused on the period 1993-2000. Inclusion criteria were symptomatic lumbar degenerative disc disease or low grade spondylolisthesis, not responding to conservative means during at least 6 months, and treated with surgical fusion of two non-contiguous spinal areas. Non-operative management consisted of pain medication, non-steroidal anti-inflammatory drugs, activity modification, physical therapy, epidural steroids, electrophysiotherapy, and bracing. Duration of symptoms ranged from 1 to 20 years (mean

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- Alihan Derincek, MD, Spine Fellow.
  - Amir Mehbod, MD, Spine Surgeon.
  - Manuel Pinto, MD, Spine Surgeon.
  - Ensor Transfeldt, MD, Spine Surgeon.

*Twin Cities Spine Center, Minneapolis, MN, USA.*

Correspondence : A. Derincek, Piper Building 913 East 26<sup>th</sup> street, Suite 600, Minneapolis, MN, 55404, USA.

E-mail : [aderincek@hotmail.com](mailto:aderincek@hotmail.com)

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Table I. — Modified Gore classification

Grade	Disc space narrowing	End plate sclerosis	Osteophyte	Olisthesis/Instability
0	none	none	none	none
1	25% decrease	barely visible	barely visible	< 3 mm
2	50% decrease	moderate	moderate	3-5 mm
3	75% decrease	severe	large	> 5 mm

Table II. — Summary of the floating discs, preoperative and postoperative Gore score

Patients	Age (yrs)	Alcohol	Obesity	Smoking	Follow-up (years)	Fused level	Floating discs	Preop Gore score	Postop Gore score
D T	46	Y	N	Y	2.5	T10-T12, L3-4	L1-2, L2-3	0	0
J K	50	N	Y	N	2	L1-2, L4-S1	L2-3, L3-4	1/1	1/1
PDL	35	Y	N	Y	2	L3-4, L5-S1	L4-5	0	0
J S	46	N	N	N	2	T12-L1, L3-4	L1-2, L2-3	0	0
GW	45	N	Y	N	3	L2-3, L5-S1	L3-4, L4-5	0	0
BS	46	Y	N	N	3	L3-4, L5-S1	L4-5	0	0
RH	67	N	Y	N	4	L1-2, L3-4	L2-3	0	0
MW	35	N	N	N	4	T12-L2, L5-S1	L2-3, L4-5	0	0
JR	56	N	Y	N	3	L2-3, L4-S1	L3-4	0	0
<b>SB*</b>	<b>57</b>	<b>N</b>	<b>N</b>	<b>N</b>	<b>4</b>	<b>T10-12, L3-5</b>	<b>L1-2*, L2-3*</b>	<b>0</b>	<b>2/1</b>
<b>KJ*</b>	<b>50</b>	<b>Y</b>	<b>N</b>	<b>Y</b>	<b>11</b>	<b>L3-4, L5-S1</b>	<b>L4-5*</b>	<b>0</b>	<b>1</b>
DZ	65	N	Y	N	2	L2-3, L4-5	L3-4	0	0
JK	45	N	N	N	4.5	L1-L4, L5-S1	L4-5	0	0
TS	48	N	N	N	5	L1-2, L4-5	L2-3, L3-4	0	0
<b>AN*</b>	<b>55</b>	<b>N</b>	<b>N</b>	<b>N</b>	<b>5</b>	<b>L2-3, L4-S1</b>	<b>L3-4*</b>	<b>0</b>	<b>1</b>
IH	75	N	N	N	8	L2-3, L4-5	L3-4	0	0
TH	52	N	N	N	5	L2-3, L4-5	L3-4	0	0
<b>WD*</b>	<b>48</b>	<b>Y</b>	<b>N</b>	<b>Y</b>	<b>7</b>	<b>L2-3, L4-5</b>	<b>L3-4*</b>	<b>0</b>	<b>1</b>
DN	31	N	N	Y	3	L3-4, L5-S1	L4-5	0	0
PG	46	N	N	N	4	L3-4, L5-S1	L4-5	0	0

\* = degenerative floating disc.

8.3 years). Fusion levels were determined by history, physical examination, Magnetic Resonance Imaging (MRI) and provocative discography. All surgeries were performed by one spine surgeon (MP).

The preoperative and postoperative anteroposterior and lateral radiographs of the floating discs were graded using the modified Gore System (grade 0-3) (table I), preoperatively and at the last follow-up.

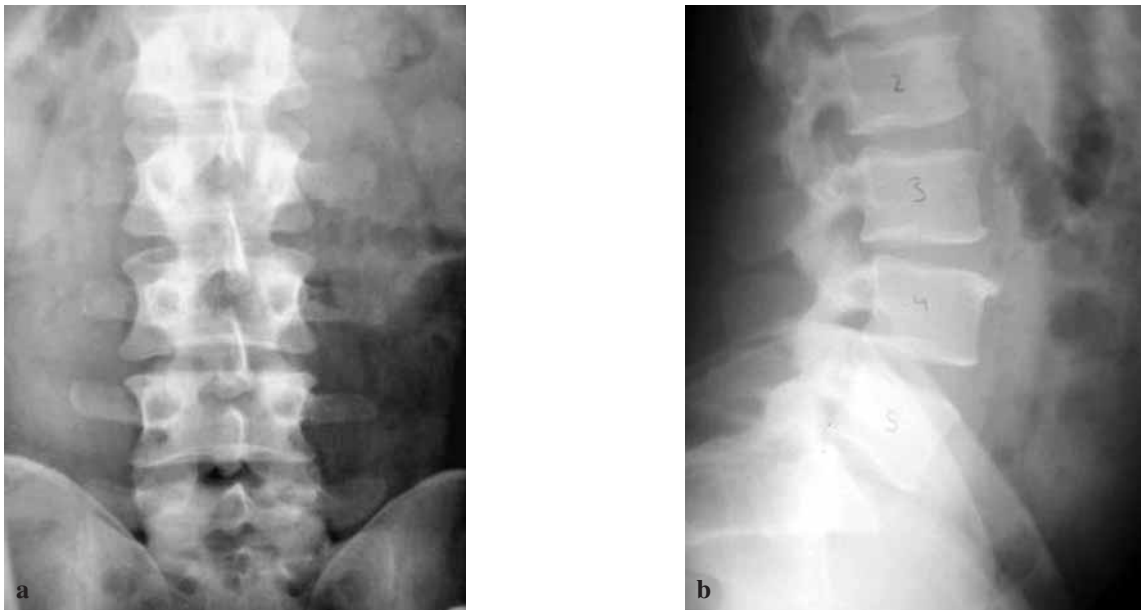
Segmental lordosis, lumbar lordosis L1-S1, and pelvic incidence were also measured on the same radiographs. The segmental lordosis was the angle between lines drawn through the superior and inferior end plates of two adjacent vertebrae. The lumbar lordosis was the angle between lines drawn through the superior end plate of L1 and the superior end plate of S1. The pelvic incidence

was the angle between 2 lines, drawn on a lateral radiograph : the perpendicular line dropped from the midpoint of the sacral end plate and the line connecting this midpoint to the center of the femoral head. Pelvic incidence is a radiographic parameter that reflects both pelvic tilt and lumbar lordosis.

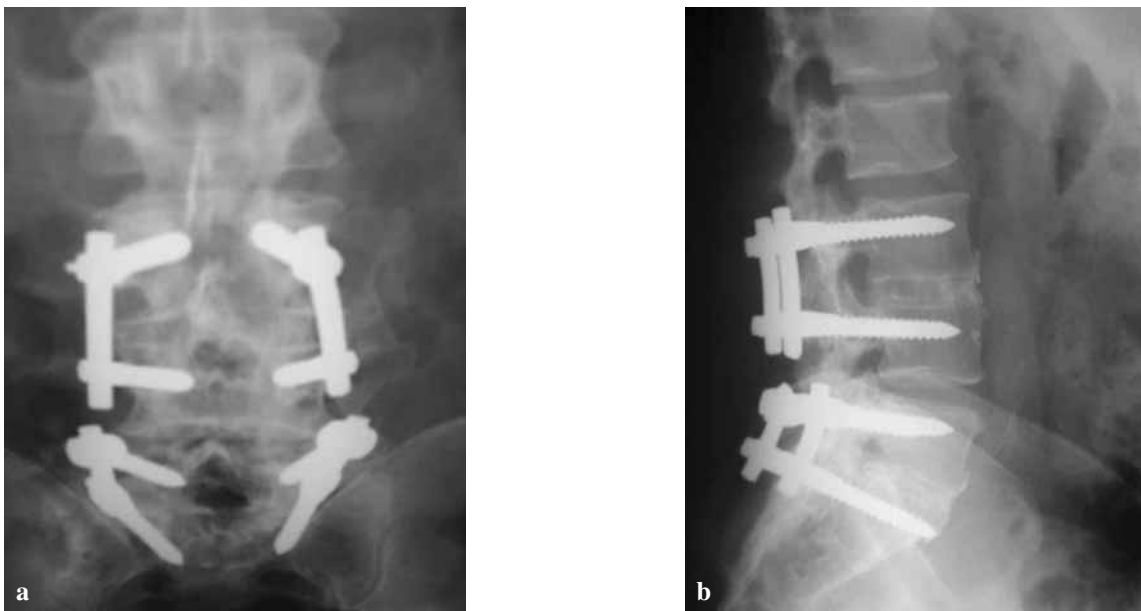
Groups were compared using the Wilcoxon signed-ranks test.

## RESULTS

There were 20 patients (12 males, 8 females) with a mean age of 49.9 years (range 31-75). The mean follow-up period was 4.2 years (range 2-11).



**Fig. 1a/b.** — Preoperative anteroposterior and lateral radiographs showing osteophyte formation L3-L4, narrowing of the L5-S1 disc and retrolisthesis of L5.



**Fig. 2a/b.** — Anterior discectomy and fusion, and posterior instrumentation and fusion were performed at the levels L3-L4 and L5-S1. After 11 years, Gore grade 1 floating disc degeneration L4-L5 is based on moderate subchondral sclerosis and anterosuperior osteophyte formation L5.

Forty-seven levels were fused and 27 floating discs were studied (13 one-level, 7 two-level). Five out of 27 floating discs (18%) in 4 patients progressively

degenerated (table II) (fig 1,2). Postoperatively, 3 of the 5 degenerated discs had decreased segmental lordosis, while the two remaining degenerated discs

Table III. — Results of segmental lordosis, lumbar lordosis and pelvic incidence

Patients	Floating disc/s	Preop segmental lordosis (degrees)	Postop segmental lordosis (degrees)	Preop lumbar lordosis (degrees)	Postop lumbar lordosis (degrees)	Preop pelvic incidence (degrees)	Postop pelvic incidence (degrees)
D T	L1-2 / L2-3	8 / 14	0 / 10	80	48	55	46
J K	L2-3 / L3-4	3 / 3	3 / 3	40	37	32	37
PDL	L4-5	20	26	45	43	50	54
J S	L1-2 / L2-3	6 / 6	6 / 3	30	30	43	44
GW	L3-4 / L4-5	15 / 39	16 / 33	59	62	82	77
BS	L4-5	26	24	39	56	48	46
RH	L2-3	7	14	44	51	59	57
MW	L2-3 / L4-5	2 / 13	7 / 12	40	44	46	53
JR	L3-4	4	5	44	37	49	45
<b>SB</b>	<b>L1-2* / L2-3*</b>	<b>4 / 4</b>	<b>4 / 4</b>	<b>29</b>	<b>48</b>	<b>54</b>	<b>42</b>
<b>KJ</b>	<b>L4-5*</b>	<b>23</b>	<b>20</b>	<b>32</b>	<b>20</b>	<b>40</b>	<b>33</b>
DZ	L3-4	14	19	50	57	48	45
JK	L4-5	27	25	59	44	47	35
TS	L2-3 / L3-4	11 / 15	14 / 16	37	48	57	60
<b>AN</b>	<b>L3-4*</b>	<b>7</b>	<b>2</b>	<b>30</b>	<b>39</b>	<b>36</b>	<b>54</b>
IH	L3-4	20	10	60	40	53	60
TH	L3-4	15	26	20		29	45
<b>WD</b>	<b>L3-4*</b>	<b>11</b>	<b>6</b>	<b>75</b>	<b>75</b>	<b>84</b>	<b>94</b>
DN	L4-5	20	23	42	37	34	45
PG	L4-5	9	25	40	49	71	67

\* = degenerative floating disc.

had no change : no correlation ( $p = 0.08$ ) (table III). Neither was there any significant correlation between floating segment degeneration and modification of lumbar lordosis L1S1 ( $p > 0.10$ ) or pelvic incidence ( $p > 0.10$ ) (table III).

## DISCUSSION

Degeneration of the disc next to a spinal fusion has been termed adjacent segment disease. There are many studies about the effects of segmental fusion on the adjacent discs in English literature (2-6,8). Potential risk factors are instrumentation, fusion length, sagittal malalignment, facet injury, age, and pre-existing degenerative changes. The development of adjacent segment degeneration may necessitate further surgical procedures. It is logical to assume that floating discs between two fusion areas may also have a higher rate of degeneration.

The rate of symptomatic adjacent segment disease is higher in patients with transpedicular instrumentation (12.2-18.5%) than in patients fused

with other forms of instrumentation or without instrumentation (5.2-5.6%) (1,7). The authors came to the same statement : in the current study all 5 degenerative floating discs were situated next to transpedicular instrumentations.

Sagittal malalignment and biomechanical alterations likely play a primary role in causing adjacent segment disease (2,4). Similarly, in the current study 3 of the 5 degenerated floating discs belonged to patients with postoperatively decreased segmental lordosis, while the two other degenerative floating discs belonged to patients without postoperative change in the segmental lordosis (difference not significant :  $p = 0.08$ ) (table III). Moreover, there was no significant correlation between floating disc degeneration and modification of lumbar lordosis L1S1 ( $p > 0.10$ ) or change of pelvic incidence ( $p > 0.10$ ) (table III). In the current series, pre-operative mean lumbar lordosis L1S1 and pelvic incidence were 44.75 and 50.85 degrees respectively. After floating lumbar surgery, mean lumbar lordosis and pelvic incidence were only slightly

changed to 45.52 and 51.95 degrees respectively, and no statistical significance was observed ( $p > 0.05$ ). This may explain why no influence of lumbar lordosis L1S1 or pelvic incidence was found. However, maintenance of sagittal alignment may be a key factor for low incidence of lumbar disc degeneration.

In addition, there was no significant correlation between radiological floating disc degeneration and obesity, smoking or alcohol consumption (table III).

### CONCLUSION

In short, this study shows that the effect of floating fusion on the floating disc is the same as the effect of contiguous fusion on adjacent discs. Indeed, the floating discs can degenerate, however at a slow pace : at an average of 4 years postoperatively, none of the floating disc had degenerated more than two radiographic grades, and none needed additional surgery. Modification of segmental lordosis, lumbar lordosis L1S1 or pelvic incidence may influence floating disc degeneration, but this was not demonstrated in the current study. Of course, maintaining sagittal alignment is probably advisable.

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