COMPLICATION

Study Design. Retrospective review and multivariate analysis.

Objectives. Recurrent lumbar disc herniation (rLDH) is a repeated disc herniation at a previously operated disc level in patients who experienced a pain-free interval of at least 6 months after surgery. We investigated whether the preoperative radiologic biomechanical factors (disc height index [DHI] and sagittal range of motion [sROM]) have any effect on rLDH.

Summary of Background Data. rLDH has been reported in 5% to 15% of patients. There have been many studies suggesting various risk factors for rLDH, such as disc degeneration, trauma, age, smoking, gender, and obesity. However, these factors did not reflect a biomechanical effect on the affected joint directly. Investigation of DHI and sROM would be helpful to understand the biomechanical impact on the occurrence of rLDH.

Methods. This study enrolled 157 patients who underwent surgery for L4–L5 LDH. We divided the patients into the recurrent and the nonrecurrent group and compared their clinical parameters (age, sex, body-mass index, symptom duration, diabetes, smoking, herniation type, preoperative visual analogue scale) and preoperative radiologic parameters (disc degeneration, DHI, sROM).

Results. rLDH occurred at 40.8 ± 15.5 months (7–70 months) after primary surgery. Mean DHI was 0.37 ± 0.09 and 0.29 ± 0.09 in the recurrent and the nonrecurrent group, respectively ($P < 0.05$). Mean sROM was 11.3° ± 2.9° and 5.9° ± 3.7° in the recurrent and the nonrecurrent group, respectively ($P < 0.05$). Both smoking and disc degeneration were related with the development of rLDH ($P < 0.05$).

Conclusion. Together with our data, DHI and sROM showed a significant correlation with the incidence of recurrent lumbar disc herniation, suggesting that preoperative biomechanical conditions of the spine can be an important pathogenic factor in the site of lumbar disc surgery.

1.Recurrent Disc

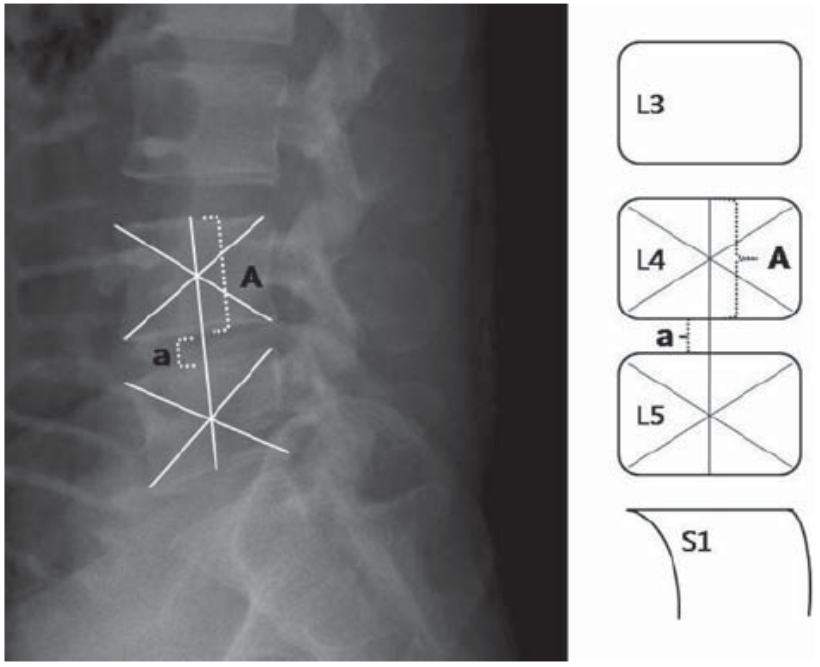

Figure 1. Radiographic measurement of the disc height index (DHI). Heights of the vertebral body and disc are measured using the midvertebral line. The midvertebral line is the line connecting the L4 and L5 centers. The center of the vertebral body is a crossing point of 2 diagonal lines of each vertebral body. DHI = a/A.

Recurrent Disc

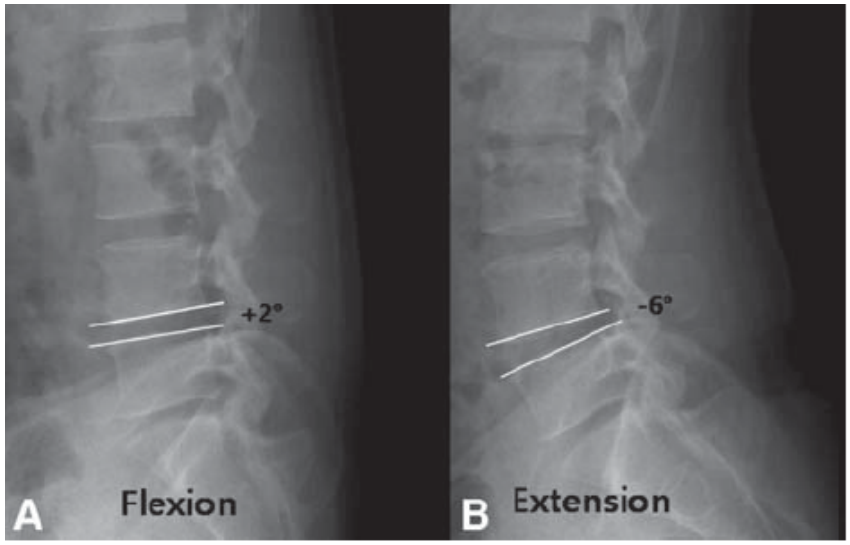

Figure 2. Method of measuring alignment using the superior and inferior endplate of L4–L5. The sagittal range of motion (sROM) of L4–L5 can be calculated by the difference between flexion (**A**) and extension (**B**) angles. The sROM at L4–L5 is 8° in this patient.

Table 1. Modified Grade of Disc Degeneration by Pfirrmann

Grade	Structure	Distinction of Nucleus and Anulus	Signal Intensity	Height of Intervertebral Disc	DHI
I	Homogeneous, bright white	Clear	Hyperintense, isointense to CSF	Normal	≥0.3
II	Inhomogeneous with or without horizontal bands	Clear	Hyperintense, isointense to CSF	Normal	≥0.3
III	Inhomogeneous, grey	Unclear	Intermediate	Normal to slightly decreased	≥0.2
IV	Inhomogeneous, grey to black	Lost	Intermediate to hypointense	Normal to slightly decreased	≥0.2
V	Inhomogeneous, grey to black	Lost	Intermediate to hypointense	Moderately decreased	≥0.15, <0.2
VI	Inhomogeneous, black	Lost	Hypointense	Collapsed disc space	<0.15

DHI includes disc height index.

Summary

- Discectomy-related complications occur in 15% to 30% of patients, including hemorrhage, infection, nerve injury, epidural scar formation, dural injury, instability, and recurrent herniation.

- In particular, recurrent lumbar disc herniation (rLDH), one of the major causes of surgical failure, has been reported in 5% to 15% of patients.

- Suk young age, male gender, smoking, and traumatic events as risk factors.

- Cinotti *et al6* reported that some risk factors were found to be associated
- with ipsilateral recurrent herniation; male patients with marked degenerated discs were more likely to experience recurrent herniation

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Table 2. Risk Factors for rLDH Using Univariate Analyses

	Recurrent Group (n = 14)	Nonrecurrent Group (n = 143)	*P*
Clinical parameters			
Sex (M:F)	11:3	88:55	0.167*
Mean age (yr)	49.7 ± 14.4	44.1 ± 15.6	0.194*
Mean symptom duration (mo)	3.1 ± 0.4	3.0 ± 0.6	0.579
DM (+): DM (−)	2:12 (14.3%)	14:129 (9.8%)	0.638
Smoking (+): smoking (−)	10:4 (71.4%)	55:88 (38.5%)	0.023†
Mean BMI	23.7 ± 3.8 kg/m^2	24.0 ± 3.4 kg/m^2	0.724
Preoperative VAS	7.1 ± 1.3	7.4 ± 1.2	0.453
Radiologic parameters			
Disc degeneration			0.067*
No. group A (grade I, II, VI)	1	45	
No. group B (grade III, IV, V)	13	98	
DHI	0.37 ± 0.09	0.29 ± 0.09	0.001†
SROM	11.3° ± 2.9°	5.9° ± 3.7°	0.000†

- Disc degeneration contributes to changes of annular collagen and
- induces annular tears.[Gruber *BMC Musculoskelet Disord 2002;3:9.*23]

- The healing processes which occur in the outer lamellas after annular injury may not be enough for effective reconstitution of the external annulus in degenerated discs.

- These reports support our finding that the incidence of rLDH was higher in discs
- with degeneration grades III, IV, and V than those with grades I and II.

In disc degeneration grade VI
reported that segmental motion decreased proportionally to the degree of disc
- degeneration. Kirkaldy-Willis and Farfan29 proposed the concept of the progression of disc degeneration, which consists of dysfunction, unstable, and restabilization phases.

- These results suggest that collapsed discs (DHI 0.15) are biomechanically more stable than those with preserved disc height, resulting in a low incidence of rLDH.

- Among radiologic parameters, sROM appeared to be the most important risk factor of rLDH in our study (*P* 0.01). In particular, if the sROM was more than 10°, the recurrent rate was 26.5% (9/34), whereas if it was less than 10°, the rate was 4.1% (5/123).

- The sROM is mostly affected by disc and facet joints26,30,31 and is related with stress on the corresponding disc.26 This biomechanical stress would affect the development of rLDH. T

Kim. **Spine • Volume 34 • Number 1 • 2009**

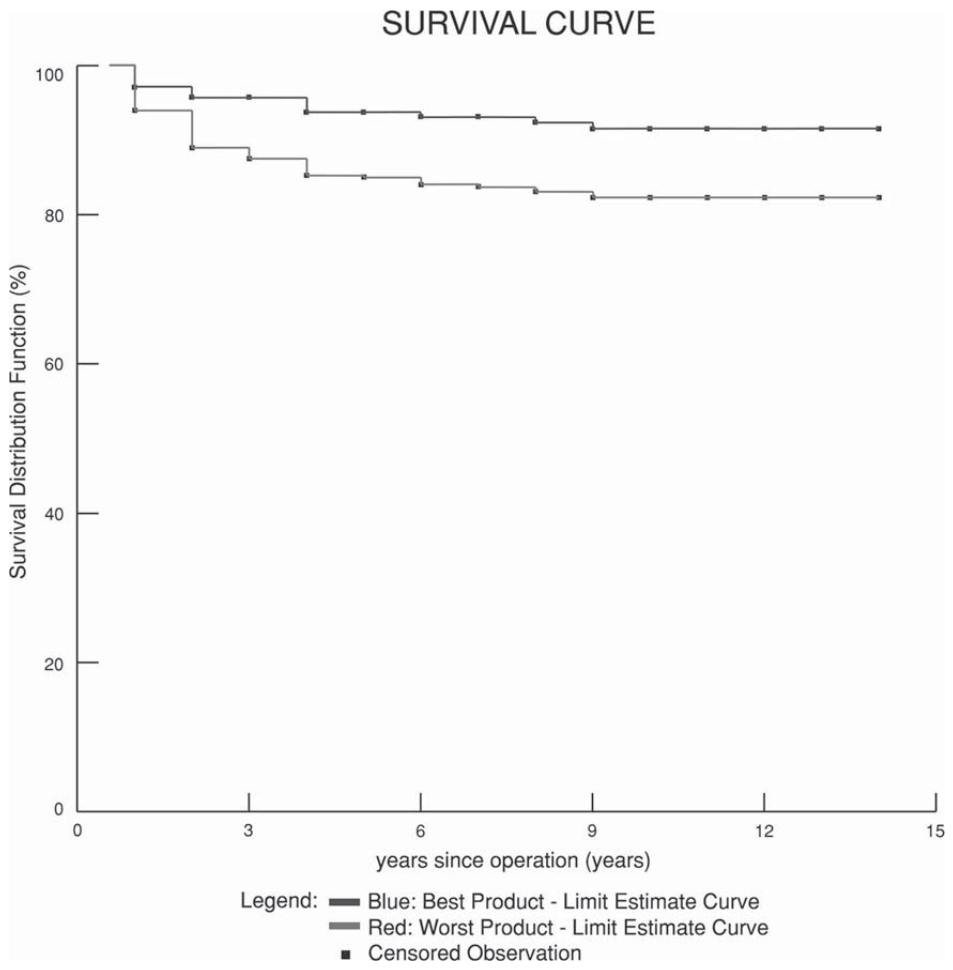
- Higher incidence of recurrent herniation in young men, it has been suggested that the annular incision made at primary surgery makes the operated disc more susceptible to sudden prolapse, particularly under conditions of mechanical overload experienced during sports activity

- The present study defined recurrence as symptom recurrence after a pain-free interval greater than 6 months associated with compatible lesions demonstrated by MRI with gadolinium enhancement at the same level as
- that of the primary diagnosis.

- The association of recurrence rate with the type of disc herniation is still not conclusive.

- The recurrence rate continued to rise steadily as time goes by until 9 years after surgery in our series; it was 2.8% in patients followed at 1 year, 6.2% at 5
- years, and 8.5% at 9 years

The recurrence rate of disc herniation increased with time after surgery. As such, survival analysis provides a more accurate estimation of true recurrence rate.



2.CAUDA EQUINA *Acta Orthopaedica 2010; 81 (3): 391–395*

- We conclude that bilateral radiculopathy or sciatica are early stages of CES and indicate a high risk of development of advanced CES.

- Electrophysiological abnormalities and reduced saddle sensation are indices of early diagnosis.

- Patients at the preclinical and early stages have better functional recovery than patients in later stages after surgical decompression.

- CES refers to impairment of the cauda equina and clinically it may manifest as low back pain, saddle anesthesia, bilateral sciatica, motor weakness of the lower extremities, paraplegia, and bowel, bladder, or sexual dysfunction (Byrne 1993).

- Although this definition may include patients without CES, this concept of CES can allow the clinician to identify patients who have a high risk of developing “full-blown CES

- The common symptoms of early CES include low back pain and bilateral radicular leg pain.

- In addition, our results demonstrated that surgery could help patients with slight saddle sensory disturbance and bilateral sciatica (patients in group 2), or severe saddle sensory disturbance, bowel or bladder dysfunction, motor weakness of the lower extremities and reduced sexual performance (patients in group 3).

- Conversely, patients with extensive nerve damage from severe and prolonged compression (group 4) were not helped by surgical intervention.

- Surgical goals are treatment is less effective for late-stage patients, nonoperative treatment of late-stage patients delays appropriate management and most likely leads to poorer outcomes
- Disintegration of the bilateral reflex arches is believed to be the pathogenesis of cauda equina injury. Thus, bilateral radiculopathy may be the critical symptom that indicates
- a high risk of development of CES.

- Group 1 Low back pain with only BCR (bulbo-cavernosus reflex) and ICR (ischio-cavernosus reflex) abnormalities and no typical symptoms of CES.

- Group 2 He had slight saddle sensory disturbances and bilateral sciatica.

- Group 3 Patients had severe saddle sensory disturbances, bowel and/or bladder dysfunction, motor weakness of the lower extremities and reduced sexual function.

- Group 4 Patients had no saddle sensation, no sexual function, and uncontrolled bowel function.

3.OA after Discectomy

- Eur Spine J. 2010 Jan;19(1):136-43. Epub 2009 Nov 6.. **Frequency and clinical meaning of long-term degenerative changes after lumbar discectomy visualized on imaging tests.**Mariconda M, Galasso

- Retrospective controlled study was to evaluate radiographic degeneration in the lumbar spine of patients who had undergone lumbar discectomy minimum 21 years earlier

- 50 patients who had undergone discectomy for lumbar disc herniation.

- The mean length of follow-up:25.3 +/- 3.0 years. Short Form-36, Oswestry Disability Index, and a studyspecific questionnaire. Radiographic views

- A five-step published classification was used to assess the increasing severity of radiographic changes.
- CT or MRI scans were also available for 27 patients who had undergone discectomy.

- Moderate to severe radiographic changes were present in 45 patients (90%) and 34 controls (68%), respectively (P = 0.013).

- The most prevalent MRI/CT changes were loss of disc height (89%), facet joint arthritis (89%), and endplate changes (57%).

- Thirty-two of 33 subjects (97%) reporting pain during the last 12 months had significant degeneration on their radiographs, and the frequency of changes was higher with respect to subjects without pain (P = 0.040).

- In conclusion, standard lumbar discectomy frequently leads to long-term degenerative changes on imaging tests. The presence of moderate to severe degeneration is associated with self-reported pain.

4.MRI [post-disc]: Scar Vs Recurrence

- Clin Radiol. 2002 Nov;57(11):969-81.

- **Abstract**
- Complications of such surgery include recurrent/residual disc herniation, epidural scar formation, discitis, arachnoiditis and pseudo-meningocele.

- Gadolinium-enhanced MRI is the technique of choice for investigating recurrent symptoms following discectomy.

- This article reviews the normal early and late post-laminectomy MR appearances, as well as the pathological findings associated with the above-mentioned complications.

The postoperative lumbar spine

- Acta Radiol Suppl. 1998;414:1-23.
- Disc herniations were found in 16% of the disc levels in asymptomatic patients and in 38% of the disc levels in the symptomatic patients. Significantly more disc herniations were found in patients who had only a short duration of recurrent symptoms (maximum 3 months) before MR investigation than in the asymptomatic patients. Nerve-root displacement due to disc herniation was also significantly more frequent in patients with the short symptom duration than in patients with a longer symptom duration.
- True intradural nerve-root enhancement was found in 7% of symptomatic patients, and focal enhancement in the root sleeve was found in 26% of them; there was good correlation to clinical symptoms and other pathological findings. Thickened nerve roots were found with equal frequency in asymptomatic and symptomatic patients. Epidural scar tissue diminished with time, showing no significant difference between asymptomatic and symptomatic patients.
- Out of 6 patients with septic post-operative discitis, 3 showed extensive MR changes; the remaining 3 showed moderate changes which were similar to those in another 6 patients who had aseptic discitis.
- Nerve-root displacement and nerve-root enhancement caused by recurrent disc herniation may strengthen the indication for repeat discectomy.
- On the other hand, the finding of a thickened nerve root seems to be of no diagnostic value. The MR features in postoperative discitis develop only gradually and the differentiation between septic and aseptic forms of discitis is thus difficult at the early stage.

Adjacent segment Spine J. 2011 Jan;11(1):11-20.

- **Incidence and prevalence of surgery at segments adjacent to a previous posterior lumbar arthrodesis.**
- Sears WR, Sergides IG, Kazemi N, Smith M, White GJ, Osburg B.
- Department of Neurosurgery, Royal North Shore Hospital, Sydney, NSW 2065, Australia. sears.public@mac.com
- Comment in:
- Spine J. 2011 Jan;11(1):21-3.
- **Abstract**
- BACKGROUND CONTEXT: Adjacent segment disease (ASD) after lumbar spinal fusion has been an important reason behind the development of nonfusion stabilization technology. However, the incidence, prevalence, and factors contributing to adjacent segment degeneration in the lumbar spine remain unclear. A range of prevalence rates for ASD have been reported in the lumbar spinal literature, but the annual incidence has not been widely studied in this region. Conflicting reports exist regarding risk factors, especially fusion length.
- PURPOSE: To determine the annual incidence and prevalence of further surgery for adjacent segment disease (SxASD) after posterior lumbar arthrodesis and examine possible risk factors.
- STUDY DESIGN: Retrospective cohort study.
- PATIENT SAMPLE: Nine hundred twelve patients who underwent 1,000 consecutive posterior lumbar interbody fusion procedures, with mean follow-up duration of 63 months (range, 5 months-16 years).
- OUTCOME MEASURES: Further surgery for ASD or surgery-free survival.
- METHODS: A postal and telephone survey. Follow-up rate: 91% of patients. The annual incidence and prevalence of ASD requiring further surgery were determined using Kaplan-Meier survivorship analysis. Cox proportional-hazards (Cox) regression was used for multivariate analysis of possible risk factors. Significance was set at $p<.05$.
- RESULTS: Further surgery for ASD occurred following 130 of 1,000 or 13% of procedures at a mean time of 43 months (range, 2.3-162 months). The mean annual incidence of SxASD over the first 10 years, in all patients, was 2.5% (95% confidence interval [95% CI], 1.9-3.1) with prevalences of 13.6% and 22.2% at 5 and 10 years, respectively. Cox regression modeling found that the number of levels fused ($p\leq.0003$), age of the patient, fusing to L5, and performing an additional laminectomy adjacent to a fusion all independently affect the risk of SxASD. The mean annual incidence figures in the first 10 years after a lumbar fusion were 1.7% (95% CI, 1.3-2.2) after fusion at single levels, 3.6% (2.1-5.2) after two levels, and 5.0% (3.3-6.7) after three and four levels. The 5- and 10-year prevalences were 9% and 16%, 17% and 31%, and 29% and 40% after single-, two-, and three-/four-level fusions, respectively. The risk of SxASD in patients younger than 45 years was one-quarter (95% CI, 10-64) the risk of patients older than 60 years ($p=.003$). A laminectomy adjacent to a fusion increases the relative risk by 2.4 times (95% CI, 1.1-5.2; $p=.03$). Stopping a fusion at L5 is associated with a 1.7-fold increased risk (95% CI, 1.2-2.4; $p=.007$) of SxASD compared with a fusion to S1, for fusions of the same length.
- CONCLUSION: The overall annual incidence and predicted 10-year prevalence of further surgery for ASD after lumbar arthrodesis were 2.5% and 22.2%, respectively. These rates varied widely depending on the identified risk factors. Although young patients who underwent single-level fusions were at low risk, patients who underwent fusion of three or four levels had a threefold increased risk of further surgery, compared with single-level fusions ($p<.0001$), and a predicted 10-year prevalence of 40