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Retrolisthesis and lumbar disc herniation: a postoperative assessment of patient function

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Abstract

BACKGROUND CONTEXT—The presence of retrolisthesis has been associated with the degenerative changes of the lumbar spine. However, retrolisthesis in patients with L5–S1 disc herniation has not been shown to have a significant relationship with worse baseline pain or function. Whether it can affect the outcomes after discectomy, is yet to be established.

PURPOSE—The purpose of this study was to determine the relationship between retrolisthesis (alone or in combination with other degenerative conditions) and postoperative low back pain, physical function, and quality of life. This study was intended to be a follow-up to a previous investigation that looked at the preoperative assessment of patient function in those with retrolisthesis and lumbar disc herniation.

STUDY DESIGN—Cross-sectional study.

PATIENT SAMPLE—Patients enrolled in SPORT (Spine Patient Outcomes Research Trial) who had undergone L5–S1 discectomy and had a complete magnetic resonance imaging scan available for review (n=125). Individuals with anterolisthesis were excluded.

OUTCOME MEASURES—Time-weighted averages over 4 years for the Short Form (SF)-36 bodily pain scale, SF-36 physical function scale, Oswestry Disability Index (ODI), and Sciatica Bothersomeness Index (SBI).

METHODS—Retrolisthesis was defined as a posterior subluxation of 8% or more. Disc degeneration was defined as any loss of disc signal on T2 imaging. Modic changes were graded 1 to 3 and collectively classified as vertebral end plate degenerative changes. The presence of facet

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arthropathy and ligamentum flavum hypertrophy was classified jointly as posterior degenerative changes. Longitudinal regression models were used to compare the time-weighted outcomes over 4 years.

RESULTS—Patients with retrolisthesis did significantly worse with regard to bodily pain and physical function over 4 years. However, there were no significant differences in terms of ODI or SBI. Similarly, retrolisthesis was not a significant factor in the operative time, blood loss, lengths of stay, complications, rate of additional spine surgeries, or recurrent disc herniations. Disc degeneration, modic changes, and posterior degenerative changes did not affect the outcomes.

CONCLUSIONS—Although retrolisthesis in patients with L5–S1 disc herniation did not affect the baseline pain or function, postoperative outcomes appeared to be somewhat worse. It is possible that the contribution of pain or dysfunction related to retrolisthesis became more evident after removal of the disc herniation.

Keywords

Retrolisthesis; Postoperative; Lumbar discectomy; Lumbar disc herniation; Degenerative lumbar disease

Introduction

Low back pain affects up to 30% of the population at any given time [1]. Several sources have been implicated, including intervertebral discs, facet joints, vertebrae, neural structures, muscles, ligaments, and fascia [2]. Retrolisthesis, which is defined as the backwards slippage of one vertebral body on another, has also been associated with back pain and impaired function [3–6]. Series have shown that retrolisthesis may be present in up to 30% of extension radiographs of patients complaining of chronic low back pain [7]. In theory, when combined with intervertebral disc pathology, retrolisthesis may potentially cause increased pain or create a more difficult entity to manage.

In the previous study examining preoperative patient function, there was no significant relationship between retrolisthesis in patients with L5–S1 disc herniation and worse baseline pain or function [8]. Retrolisthesis was also not associated with an increased incidence of having degenerative disc disease, posterior degenerative changes, or vertebral end plate changes.

Isolated lumbar disc herniation [9] and retrolisthesis are known to cause pain. Patients with both ailments who undergo discectomy may not receive the same relief as those with a single identifiable cause. When one source of pain is removed, does the other take its place? There is a paucity of data that looks at the outcomes of these patients after lumbar discectomy. We sought to investigate whether postoperative low back pain, physical function, and quality of life are worse in patients with concomitant retrolisthesis (alone or in combination with other degenerative conditions). Because retrolisthesis may occur more commonly than once believed, it is important to study its role in patients complaining of low back pain and impaired back function.

Materials and methods

Study population

Individuals for this study were drawn from those enrolled in SPORT (Spine Patient Outcomes Research Trial) a randomized study, and a multicenter database of spine patients from 13 institutions across the United States. All individuals in the present study population had complete sets of magnetic resonance imaging (MRI) scans confirming a L5–S1 level

disc herniation and subsequently underwent L5–S1 discectomy. Individuals with anterolisthesis were excluded from this study. One hundred twenty-five individuals between 2001 and 2004 were identified for inclusion in this study.

MRI scans

Magnetic resonance images of the lumbar spine were viewed and evaluated on a digital monitor using eFilm software (Merge EMed, Inc., Milwaukee, WI, USA). Clinical scans were collected so there was no predefined magnet strength or acquisition protocol. All images were done supine.

Vertebral measurements and assessment

There are many published methods for determining the amount of listhesis radiographically (expressed in millimeters of subluxation or percent slippage) [10–15]. Retrolisthesis in this study was determined by measuring the position of the vertebral body of L5 relative to S1 on the central-most T1 sagittal MRI. The central sagittal image was determined by the presence of the lumbar spinous processes within the view, having a symmetrical progression of MRI images from laterally based foraminal views to the central image and having the largest measured value for the anteroposterior diameter of L5 and S1 vertebral bodies. Points were then placed along the posterior margins of L5 and S1 on the central sagittal image to measure the amount of backward slippage to the nearest 0.1 mm. All measurements were performed electronically. Percent subluxation was calculated for any individual with a posterior displacement of 3 mm or more. A cutoff point of 3 mm was chosen because this criterion has been used previously both in orthopedic research and clinical practice [3,4,13,16–18]. This 3-mm cutoff corresponded to a slip of 8% that was used as the lower limit to define retrolisthesis. Percent retrolisthesis was calculated by dividing the backwards subluxation of L5 by the anteroposterior diameter of S1.

T1 and T2 axial and sagittal images were also used to assess the degenerative changes at the L5–S1 level. The three areas of L5–S1 evaluated for degenerative changes included the disc space, vertebral end plates, and posterior elements. Loss of disc signal intensity on T2 imaging (signifying disc dehydration) was classified in this article as a sign of early disc degeneration and categorized as a degenerative change. Vertebral end plates were assessed for degenerative changes and classified under the Modic scale. For analytical purposes, stratification between Modic 1, 2, and 3 changes was not done in this article, and all the Modic changes were combined and categorized collectively as a degenerative change of the vertebral end plates. Signs of posterior element degenerative changes included signs of facet joint arthropathy and ligamentum flavum hypertrophy. Stratification between different posterior element degenerative changes was not performed, and all changes were collectively classified together as a sign of posterior element degenerative change.

Kappa values from a sample of 50 images were previously reported and showed excellent agreement: presence of retrolisthesis (1.0); loss of T2 disc signal intensity (0.73); occurrence of posterior element degeneration (0.8); and presence of modic changes (0.75) [8].

SPORT study follow-up and complications

Information obtained from the follow-up evaluations at 6 weeks, 3 months, 6 months, 1 year, 2 years, and 4 years allowed the calculation of Short Form-36 bodily pain and physical function scales (0–100; 0 being worst and 100 best health), Oswestry Disability Index (ODI) (0–100; 0 being no disability and 100 completely disabled), and Sciatica Bothersomeness Index (SBI) (rated 0–24; 0 being not bothersome and 24 being extremely bothersome). Patients were also analyzed for differences in intraoperative and postoperative complications/events.

Data analysis

Comparison of outcomes between patients with and without retrolisthesis were performed by evaluating the change from baseline using a mixed-effects model of longitudinal regression including a random individual effect to account for the correlation between repeated measurements from the same patient. Outcomes were calculated as the time-weighted average (area under the curve) over 4 years. Adjustments were made for center, age, compensation status, and baseline scores. Computations were done using SAS procedures PROC MIXED for continuous data with normal random effects, and PROC GENMOD for binary and non-normal secondary outcomes, software version 9.1 (SAS Institute, Inc., Cary, NC, USA). Statistical significance was defined as $p < .05$ based on a two-sided hypothesis test.

Results

Relation of retrolisthesis and degenerative changes to postoperative pain and function

When evaluating patients with and without retrolisthesis, some differences became apparent (Table 1). Although there was no difference appreciated preoperatively in any of our measured criteria, postoperative scores did in fact show that patients with retrolisthesis had worse bodily pain and physical function over 4 years. No differences were found in ODI or SBI.

The presence of degenerative changes did not show a significant difference in any measured category either preoperatively or postoperatively.

Longitudinal assessments of the outcomes over time are shown in the Figure. This suggests that the major differences between those with and without retrolisthesis began to appear after 6 months and began to diminish between 3 and 4 years postoperatively.

Operative information, complications, and repeat surgery rates

No statistical difference between patients with and without retrolisthesis was found in any recorded category. Intraoperative measures, such as operative time, blood loss, and blood replacement, were similar. There was also one intraoperative complication of dural tear/spinal fluid leak in each group. Postoperative events, such as superficial or deep infection, additional spine surgeries, or recurrent disc herniation, exhibited no difference as well (See Table 2).

Discussion

Retrolisthesis has been shown to cause narrowing of the disc space when the annulus fibrosus bulges posteriorly [16]. Concurrently, there can be a relative translation of the superior articular process of the vertebra caudal to the mobile segment in the direction of the intervertebral foramen. This can cause a lateral stenosis that can produce painful radicular symptoms [17]. Investigations of white [5] and African American [6] women both concluded that retrolisthesis was associated with a higher likelihood of low back pain. Although once believed to be a benign finding, it is becoming more apparent that retrolisthesis can be a source of morbidity for patients.

However, in our previous study, we were unable to show any statistical difference in the preoperative back pain and dysfunction when comparing individuals with retrolisthesis (alone or in combination with other segmental degenerative processes) and L5–S1 disc herniations with individuals with L5–S1 disc herniations without retrolisthesis (alone or in combination with other segmental degenerative changes) [8]. It was speculated at that point

that the contribution of pain and dysfunction from the disc herniation hid any possible sequelae from the retrolisthesis.

The postoperative data shows that with time, the effects of retrolisthesis may be clearer. Although there is no appreciable difference at the first follow-up of 3 months, at 1 year patients with retrolisthesis exhibited greater bodily pain that continued through the 2-year and 4-year follow-up points. It is possible that after the removal of the offending disc and recovery from the actual lumbar discectomy procedure, pain caused by retrolisthesis was no longer overshadowed. Similarly, physical function was significantly worse in retrolisthesis patients at the 2-year mark. There was a trend toward worse function at 4 years as well, but this did not reach statistical significance. Interestingly, however, ODI and SBI were unaffected by the presence or absence of retrolisthesis.

Overall complications were also unaffected by retrolisthesis. It was once believed that the presence of retrolisthesis in discectomy patients meant a higher likelihood of recurrent herniation and repeat surgery. Similar to patients with spondylolisthesis [18], fusion after discectomy was considered at times to provide greater stability to the involved vertebral segments. However, our study failed to show any correlation between retrolisthesis and increased rates of complications up to 4 years after surgery.

Within the same cohort of patients, other degenerative changes were analyzed with respect to the same outcome measures. This analysis was performed to ensure that any changes in the postoperative outcomes were because of the presence of retrolisthesis and not confounded by other degenerative changes. Posterior degenerative changes (disc space, vertebral end plates, and posterior elements), loss of disc signal intensity on T2 weighted MRI sequences, and modic changes of the vertebral end plates did not affect patient's pain, function, or quality of life after discectomy. Patients did better after lumbar discectomy, regardless of the presence or absence of these degenerative changes. In our cohort of patients, retrolisthesis had a greater effect on postoperative outcome than the presence of any of the studied degenerative changes.

The limitations of this study include the fact that only associations can be made because of the cross-sectional design of the study. Also, only self-reported subjective measures were used as opposed to the objective measures, such as opioid use or return to work rates. Because only patients undergoing discectomy were included, we cannot know how the group with retrolisthesis would have done with nonoperative treatment. However, a difference was found postoperatively when none was appreciated in the preoperative study. It may be prudent for the patient and the surgeon to tailor expectations when dealing with L5–S1 disc herniation with concomitant retrolisthesis.

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EVIDENCE & METHODS

Context

Retrolisthesis is a common finding in patients undergoing decompressive surgery. Whether or not the presence of preoperative retrolisthesis can negatively impact the outcome of a simple decompression/discectomy procedure (ie, no fusion) has remained heretofore unanswered.

Contribution

Using data from SPORT, the authors found that patients undergoing L5-S1 discectomy at a level with retrolisthesis had worse clinical outcomes than those without retrolisthesis despite similar pain and functional levels pre-operatively. The functional impact, as seen in standard metrics, however, was small.

Implication

This study adds to the body of literature that highlights that a “lumbar disc herniation” represents a wide range of phenotypes that can influence the response to treatment. In this particular case, a disc herniation with retrolisthesis responds differently than one without retrolisthesis. The information is important in forecasting results from surgery and possibly the prudent development of alternative treatment strategies.

—The Editors

Figure.

Primary outcomes over time by retrolisthesis with area under curve p value that compares retrolisthesis group to nonretrolisthesis group.

Table 1

SPORT IDH 4-year retrolisthesis—adjusted* weighted average 4 years change scores and group differences (AUC)

Mean (SE) at baseline		AUC of mean change from baseline (SE)			
No retrolisthesis (n=96)	Retrolisthesis (n=29)	Overall mean	No retrolisthesis	Retrolisthesis	p Value
BP 21.1 (1.6)	25.1 (3.2)	22	45.4 (1.9)	37.1 (3.6)	.043
PF 29.3 (2.5)	35.4 (3.6)	30.1	46.9 (1.9)	39.1 (3.6)	.059
ODI 57.4 (2)	51.8 (3.6)	56.2	39.4 (1.7)	34.7 (3.3)	.21
SBI 16.9 (0.48)	15.7 (1)	16.6	10.9 (0.5)	10.6 (1.1)	.79
No posterior degeneration (n=51)		Posterior degeneration (n=29)			
No posterior degeneration	Posterior degeneration	Overall mean	No posterior degeneration	Posterior degeneration	p Value
BP 22.4 (2.3)	20.5 (2.4)	21.7	41.1 (2.7)	42.6 (3.4)	.73
PF 29 (3.2)	28.6 (3.8)	27.9	46.3 (2.7)	47.5 (3.5)	.78
ODI 57.3 (2.8)	58.3 (3.2)	57.7	37.9 (2.5)	39.7 (3.2)	.66
SBI 15.8 (0.72)	18 (0.71)	16.7	10 (0.8)	10.3 (1.5)	.84
No T2 signal loss (n=28)		T2 signal loss (n=78)			
No T2 signal loss	T2 signal loss	Overall mean	No T2 signal loss	T2 signal loss	p Value
BP 20 (2.8)	22.4 (1.9)	21.9	44.8 (3.5)	44.7 (2.1)	.98
PF 37.9 (4.7)	28.1 (2.5)	30.2	44.5 (3.7)	46.2 (2.2)	.70
ODI 52.3 (3.6)	58.3 (2.2)	56.5	39.7 (3.2)	39.5 (1.9)	.97
SBI 16.2 (0.77)	16.8 (0.6)	16.6	10.8 (0.9)	19.9 (7.9)	.25
No modic changes (n=55)		Modic changes (n=22)			
No modic changes	Modic changes	Overall mean	No modic changes	Modic changes	p Value
BP 22 (2.4)	20.4 (3.3)	21.5	44.2 (2.5)	41.7 (3.9)	.59
PF 31.2 (3.4)	23.2 (4.5)	28.5	47.4 (2.5)	43.9 (3.9)	.46
ODI 57.1 (2.9)	60.3 (4.5)	58	41.1 (2.2)	36.9 (3.6)	.32
SBI 16.3 (0.73)	18.6 (0.8)	16.8	11 (0.7)	17.2 (7.9)	.43

SPORT, Spine Patient Outcomes Research Trial; IDH, intervertebral disc herniation; AUC, area under the curve; SE, standard error; SF, short form; BP, SF-36 bodily pain; PF, SF-36 physical function; ODI, Oswestry Disability Index; SBI, Sciatica Bothersomeness Index.

* Adjusted for age, gender, compensation, and baseline score.

Table 2

Retrolisthesis cohort: operative information, complications, and repeat surgery rates

	Retrolisthesis		p Value
	No (n=96)	Yes (n=29)	
Discectomy level—n (%)			
L2–L3/L3–L4	0 (0%)	0 (0%)	—
L4–L5	1 (1%)	1 (3%)	.95
L5–S1	96 (100%)	29 (100%)	—
Operation time, min (SD)	71.6 (32.4)	73.3 (23)	.80
Blood loss, cm ³ (SD)	63.7 (154.7)	52 (27.3)	.69
Had blood replacement	1 (1%)	0 (0%)	.52
Lengths of stay			.32
Same day	31 (32%)	10 (34%)	
One night	52 (54%)	18 (62%)	
More than two nights	13 (14%)	1 (3%)	
Intraoperative complications *			
Dural tear/spinal fluid leak	1 (1%)	1 (3%)	.95
None	95 (99%)	28 (97%)	.95
Postoperative complications/events †			
Wound infection—superficial	2 (2%)	1 (3%)	.79
Wound infection—deep	2 (2%)	0 (0%)	.95
Other	1 (1%)	2 (7%)	.27
None	91 (95%)	26 (90%)	.58
Additional spine surgeries (1-y rate) ‡	8 (8%)	1 (3%)	.39
Additional spine surgeries (2-y rate) ‡	10 (10%)	2 (7%)	.58
Additional spine surgeries (3-y rate) ‡	11 (11%)	2 (7%)	.49
Additional spine surgeries (4-y rate) ‡	12 (13%)	2 (7%)	.42
Recurrent disc herniation	4 (4%)	2 (7%)	
Complication or other	3 (3%)	1	
New condition	4 (4%)	0	

SD, standard deviation; CSF, cerebrospinal fluid.

* Intraoperative complications not reported: aspiration, nerve root injury, operation at wrong level, vascular injury, and “other.”

† Postoperative complications/events not reported: blood transfusion, bone graft complication, CSF leak, nerve root injury, paralysis, cauda equina injury, pseudoarthrosis, wound dehiscence, and wound hematoma.

‡ Postsurgical reoperation rates are Kaplan-Meier estimates based on time to first reoperation.