



Lumbar Disc Herniations Causing Contralateral Radicular Symptoms: Can They Be Explained by Hypotenusal Theory?

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■ **OBJECTIVE:** Cases presenting contralateral radicular symptoms are rarely encountered. It is difficult to decide on the correct side in cases where surgical intervention will be performed. The aim of the study is to explain the symptomatology in cases of lumbar disc herniations causing contralateral radicular symptoms by a hypotenusal effect.

■ **MATERIALS AND METHODS:** In total, 27 cases were included in the study. Eight cases underwent surgical interventions performed on the side where disc herniation was radiologically detected. Nineteen cases were treated conservatively. Disc herniations were radiologically evaluated in 3 different groups, and the effect on the root on the symptomatic side was explained by a hypotenusal theory. Correlations among symptomatology, clinical findings, magnetic resonance imaging, and electromyography were discussed.

■ **RESULTS:** Clinical improvement was observed in all cases that were operated on the side where disc herniation was detected radiologically. Neurologic examination findings in the postoperative period also revealed the correctness of the selected surgical approach. Electromyography is insufficient to explain clinical findings and to decide on the surgical side.

■ **CONCLUSION:** Lumbar disc herniations, which lead to contralateral radicular symptoms, should be operated from the side where the disc is radiologically detected. The top of the disc is responsible for symptomatology. Surgical

excision of the top of the disc removes the contralateral root traction and root compression on the same side.

INTRODUCTION

Lumbar disc herniation (LDH) cases, which cause radicular symptoms on the opposite side, are challenging. In these cases, it is a dilemma for the surgeon to decide the side where the surgery will be applied. Although it is accepted in the traditional approach that the side to be operated is the symptomatic side, there are also studies supporting the opposite of this idea.¹⁻³

In this study, 27 cases of LDH with radicular symptoms on the opposite side have been examined. Surgical interventions were performed on 8 of the cases. Preoperative neurologic examination and radiologic and electrophysiologic findings of all cases were evaluated. The importance of the straight leg raise test (SLRT) and Lasegue sign, which are critical neurologic examinations in LDH cases, was emphasized, and contralateral radicular symptoms were attempted to be explained by a hypotenusal effect.

MATERIALS AND METHODS

Between 2013 and 2017, 27 LDH cases presenting radicular symptoms on the opposite side were evaluated in the study. Cases of lumbar stenosis, foraminal stenosis on the symptomatic side, multilevel disc herniations, and scoliosis were excluded from the study.

Surgery was performed in 8 out of 27 cases. All cases underwent microdiscectomy performed on the side where the disc was

Key words

- Contralateral radiculopathy
- Contralateral symptoms
- Lumbar disc herniation
- Radiculopathy
- Surgery side

Abbreviations and Acronyms

- LDH:** Lumbar disc herniation
- MRI:** Magnetic resonance imaging
- SLRT:** Straight leg raise test

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Citation: *World Neurosurg.* (2018) 114:e1297-e1301.

<https://doi.org/10.1016/j.wneu.2018.03.201>

Journal homepage: www.WORLDNEUROSURGERY.org

Available online: www.sciencedirect.com

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detected with radiography. In 1 case, partial medial facetectomy was applied together with discectomy and foraminotomy was routinely performed in all cases. Bilateral microdiscectomy was performed in 1 case.

Surgical interventions were not performed in cases where motor deficits were not detected and response to conservative treatment was obtained. Five cases who did not demonstrate clinical improvement following conservative treatment underwent surgical interventions in the course of follow-up. The mean follow-up duration for cases who were followed up with conservative treatment was 8.2 months.

Tables 1 and 2 present the distribution of cases. Disc herniations were evaluated in 3 groups according to disc shape (Figure 1). Type 1 is centrally located, extending laterally (Figure 2). Type 2 is laterally located, extending vertically (Figure 3). Type 3 is laterally located, extending to the foramen (Figure 4).

Approval was obtained from the Ahi Evran University Clinical Research Ethics Committee (2017-13/144) 8 August 2017.

RESULTS

Clinical improvement was achieved in all operated cases. In 1 case, low-dose pregabalin treatment was administered due to a complaint of numbness. Nineteen patients were followed up with conservative treatment. Regarding the medication of cases in which conservative treatment was administered, nonsteroidal antiinflammatory drugs and thiocolchicoside, pregabalin or gabapentin, epidural steroid injection treatments were administered either alone or in combined form. Clinical results of the cases who were operated and under conservative treatment are listed in Tables 1 and 2.

DISCUSSION

It is difficult for surgeons to choose the surgical side in cases where LDH causes radicular symptoms on the opposite side. Although surgical interventions are recommended to be performed on the symptomatic side according to the conventional approach, series in which surgery was administered on the side

that the disc had been radiologically detected exist in the literature.¹⁻³ There are also studies in the literature that advocate bilateral operation of these cases.⁴⁻⁶ Yang et al⁷ have reported contralateral radicular symptoms associated with epidural fat. With a series of 5 cases, Akdeniz et al⁸ have suggested surgical interventions to be performed on the same side as the disc even if motor deficits were detected; they stated that a bilateral surgical approach would be an aggressive procedure in these cases, and it may cause spinal instability and chronic back pain. Choudhury et al⁴ have based radicular findings on spondylotic changes and contralateral stenosis in their series of 3 cases. Sucu et al² have described radicular symptoms with root traction in a series of 5 cases and recommended surgical interventions to be performed on the side where the disc was detected radiologically. On the basis of their series, Sucu² concluded that contralateral radicular symptoms could have resulted from cases of centrally and paracentrally located discs.

The SLRT and Lasegue sign have high sensitivity (0.80–0.97) and low specificity (0.4) in lower-level LDH cases.⁸ The diagnosis of disc herniations in both tests that impact the L5 and S1 nerve roots is one of the most critical examination findings. Stretching the sciatic nerve is aimed at this examination, and presence of findings at levels <70 degrees supports the existence of disc herniation. After disc herniation is radiologically detected by magnetic resonance imaging (MRI), the side specificity of the Lasegue test increases when deciding on the surgical side. In both tests, stretching of the sciatic nerve is desired. A traction or compression effect is individually sufficient for a positive evaluation of the test.

Because there is no formation on the symptomatic side that will lead to root irritation, surgery on this side does not cause a direct decompression effect on the root. The reason for clinical improvement seen in cases of surgery performed on the symptomatic side can be removal of bulging or protrusion on the symptomatic side that is smaller than that on the asymptomatic side; filling of the cavity formed in the intervertebral space due to discectomy by the disc on the asymptomatic side; or reduction in the volume of the disc due to partial resection of the contralateral disc during surgery. In sequestered disc herniations that lead to contralateral radicular symptoms, the surgical side must certainly

Table 1. Demographic Characteristics of Cases (Operated Group)

Case (Age/Gender)	Radiologic Side	Level of Disc Herniation	Type of Disc Herniation	Lasegue Degree	EMG	Surgical Method	VAS Scores (PreOp/PostOp)	PostOp Follow-up
Case 1 (53/female)	Left	L 4-5	Type 1	Right: 45	Bilateral chronic	MDF	8/2	15 months
Case 2 (40/Male)	Right	L 4-5	Type 1	Left: 30		MDF	7/1	16 months
Case 3 (34/female)	Right	L5-S1	Type 1	Left: 30	Left chronic	B-MDF	8/2	19 months
Case 4 (21/male)	Right	L5-S1	Type 2	Left: 45	Bilateral chronic	MDF	7/1	13 months
Case 5 (51/male)	Right	L5-S1	Type 2	Left: 30	Normal	MDF	7/2	17 months
Case 6 (67/male)	Left	L5-S1	Type 3		Bilateral chronic	MDF	8/3	33 months
Case 7 (52 male)	Left	L 4-5	Type 2	Right: 30	Left chronic	MDF	7/2	34 months
Case 8 (46/female)	Left	L 4-5	Type 3	Right: 45	Bilateral chronic	MDF	8/1	27 months

EMG, electromyography; VAS, visual analog scale; PreOp, preoperative; PostOp, postoperative; MDF, microdiscectomy with foraminotomy; B, bilateral.

Table 2. Demographic Characteristics of Cases Have Contralateral Radiculopathy with Lumbar Disc Herniation Under Conservative Treatment

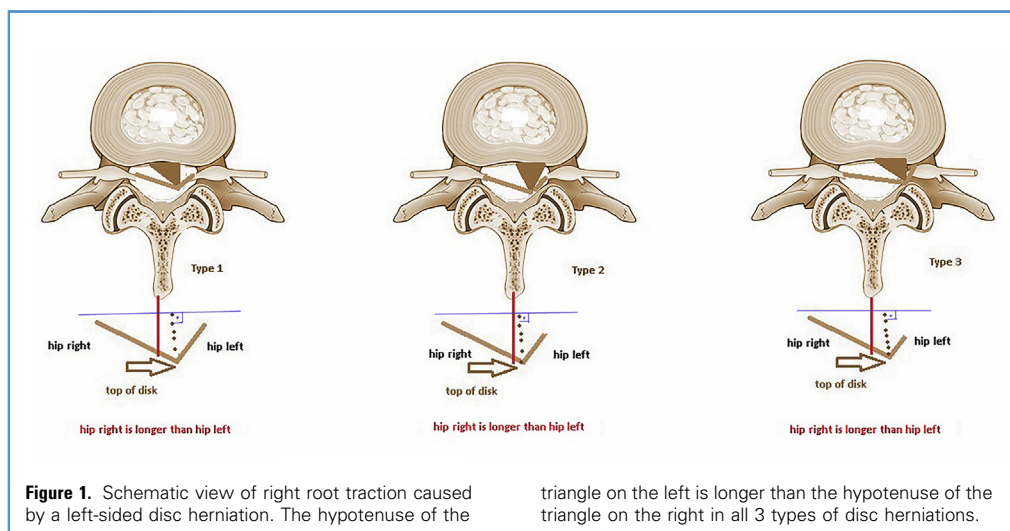
Cases (Age/Gender)	Radiologic Side/Level	Type of Disc Herniation	Lasegue Degree	EMG	Treatment	VAS Scores (Pr.T/Po.T)
Case 1 (48/f)	R/L5-S1	Type 1	45	b/c	NSAID + t.c.	6/3 (4 months)
Case 2 (52/f)	L/L4-5	Type 1			NSAID + t.c. + esi	5/2 (7 months)
Case 3 (48/f)	L/L5-S1	Type 1	45	b/c	NSAID + t.c. + p.g.	7/4 (11 months)
Case 4 (17/f)	R/L5-S1	Type 1	45		NSAID + t.c.	6/3 (2 months)
Case 5 (52/f)	L/L4-5	Type 2	30		NSAID + t.c. + esi	6/2 (4 months)
Case 6 (41/f)	R/L4-5	Type 1	30	Normal	NSAID + t.c. + p.g.	7/6 (8 months)
Case 7 (61/f)	L/L4-5	Type 1		a.s./c	NSAID + t.c. + esi	6/3 (4 months)
Case 8 (44/m)	L/L4-5	Type 1	45	a.s./c	NSAID + t.c. + p.g. + esi	5/3 (21 months)
Case 9 (50/f)	R/L5-S1	Type 1	45		NSAID + t.c. + p.g.	6/5 (14 months)
Case 10 (34/m)	R/L5-S1	Type 1	60		NSAID + t.c.	4/3 (1 month)
Case 11 (60/f)	L/L5-S1	Type 2		b/c	NSAID + t.c. + esi	6/1 (13 months)
Case 12 (56/m)	R/L5-S1	Type 2	30	a.s./c	NSAID + t.c. + p.g.	5.6/2.2 (14 months)
Case 13 (41/m)	R/L4-5	Type 2	45		NSAID + t.c.	7/3 (2 months)
Case 14 (48/m)	R/L5-S1	Type 1	30	a.s./c	NSAID + t.c. + p.g.	5/4 (19 months)
Case 15 (41/m)	L/L4-5	Type 2	45		NSAID + t.c. + p.g.	8/5 (12 months)
Case 16 (45/f)	L/L5-S1	Type 1	45	a.s./c	NSAID + t.c.	7/3 (2 months)
Case 17 (57/m)	L/L4-5	Type 2	60	b/c	NSAID + t.c. + p.g.	6/3 (14 months)
Case 18 (60/m)	L/L5-S1	Type 3	45		NSAID + t.c. + p.g. + esi	6/2 (18 months)
Case 19 (58/m)	L/L5-S1	Type 1	30		NSAID + t.c.	6/3 (2 months)

EMG, electromyography; VAS, visual analog scale; Pr.T, pretreatment; Po.T, post treatment; f, female; b, bilateral; c, chronic; R, right; NSAID, nonsteroidal antiinflammatory drug; t.c., thio-colchicoside; L, left; esi, epidural steroid injection; m, male; p.g., pregabalin; a.s., affected side.

be considered the side on which the disc herniation is located. This is because the reduction of the volume of the intervertebral disc in these cases will not have a decompressive effect on the root. Besides, even if partial, the surgical reduction of the volume

of the sequestered disc will not remove the traction effect on the opposite root.

Figure 1 schematizes the effects of disc herniation traction on the asymptomatic side on disc herniation on the symptomatic



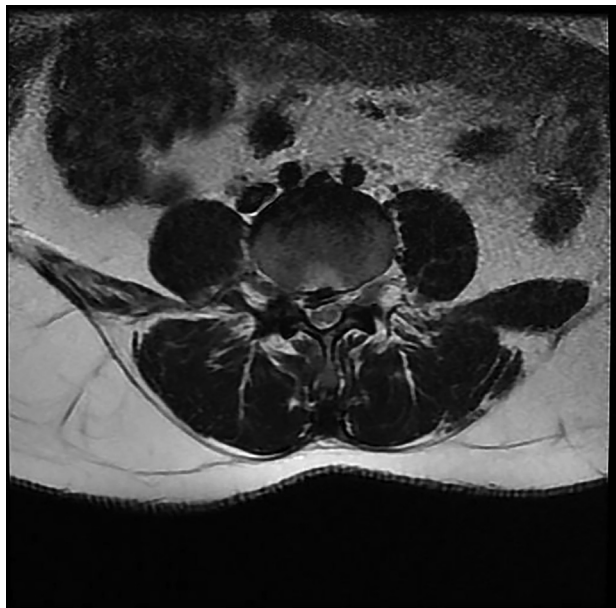


Figure 2. Contralateral radiculopathy caused by centrally located disc herniation extending to lateral.

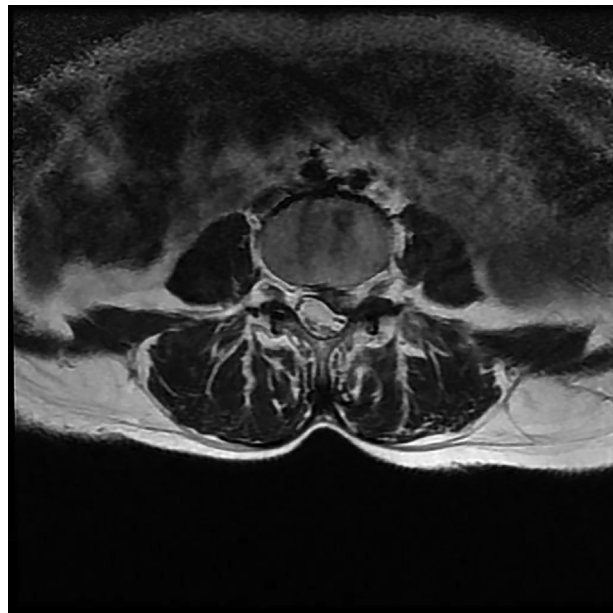


Figure 4. Contralateral radiculopathy caused by laterally located disc herniation extending to the foramen.

side. The distance where the root extends from the apex of the disc to the foramen is termed the *hypotenusal edge*. It has been demonstrated that the root length on the symptomatic side was always higher than the root length on the asymptomatic side.

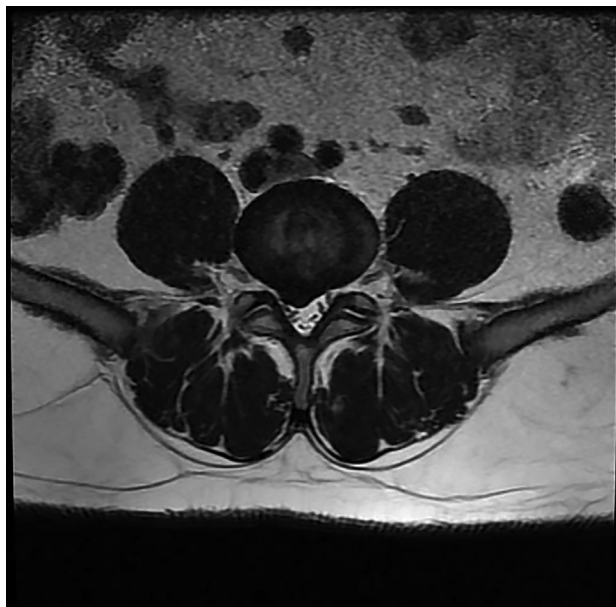


Figure 3. Contralateral radiculopathy caused by laterally located disc herniation extending vertically.

For this reason, it is expected that both the SLRT and Lasegue sign will be positive on the symptomatic side. When positive results from both tests are evaluated together with MRI, an increase in specificity is achieved when deciding which side the surgery will be performed.

It is also possible that radicular symptoms present on the opposite side in disc herniations where the apex of the disc extends toward the asymptomatic side. Radicular signs are not expected if there is no significant root compression or traction in the atypically contoured disc herniations that are laterally located but face the apex medially.

If radicular symptoms presented on the opposite side in laterally or foraminally located disc herniations, it should be considered that the traction effect on the root would cause more irritation than the compression effect to which the root on the same side of the disc is exposed. It has been stated in a study by Sucu et al² that central or paramedian disc herniations could cause contralateral symptoms. However, even though it is rarely encountered, contralateral symptoms have been detected in 3 cases that presented lateral locations but in the type 3 category. It has been shown and reported that in these cases, the traction effect that the disc caused on the opposite root resulted in more irritation than the compression effect and the hypotenusal length extending from the disc apex to the foramen is greater.

The primary pathology causing root traction is associated with the top of the disc. The longer the distance from the posterior longitudinal ligament to the top of the disc, the higher the hypotenusal length; therefore root traction will be greater.

Per the definition of a right triangle, the longest side of the triangle is the hypotenuse. An increase in the length of 1 leg causes the hypotenuse to get longer. For this reason, the more the disc

protrudes with a right angle, the more the hypotenuse will lengthen, and this will cause a root traction exceeding the length of the protruding disc. Along with causing root compression on the same side, the protruding disc results in a root traction that exceeds its length at the side of the hypotenuse. For this reason, excision of the disc base may not reduce root traction as long as the top of the disc is not excised. Therefore not only paramedian or centrally located discs, but also extruded or sequestered discs extending to the foramen, may cause traction on the opposite root.

In total, 27 cases were examined with electromyography (EMG) and the findings obtained from 17 cases did not fully support the explanation of radicular symptoms. While 2 cases' electromyograms were normal and chronic involvement in both roots were detected in 8 cases, data consistent with the side where the disc exists were obtained in 3 cases and data consistent with chronic involvement of the root on the asymptomatic side were obtained in 4 cases. In these cases, the sensitivity of EMG was considered to be high for revealing the LDH level and diagnosis but low for surgical side specificity. Considering that in contralateral disc herniations the asymptomatic side will present root compression and symptomatic side root traction, EMG examinations that show both roots are affected have low specificity to determine the surgical side.

SLRT and Lasegue tests were found to be positive in 7 of 8 cases that were operated. Both tests demonstrated in the early

postoperative period (10–14 days) that the sciatic nerve tension angle had significantly increased.

CONCLUSION

LDH cases resulting in contralateral symptoms are challenging. Bilateral surgical intervention is considered an aggressive intervention. Surgery done on the symptomatic side is unnecessary because there is no pathology requiring surgical intervention and it can indirectly lead to findings of relieved symptoms only because of a decrease in disc volume. The reason for the symptoms and the most critical factor leading to tension of the contralateral root is the top of the disc and its excision provides more root detracting. The specificity of EMG for revealing the affected root is low, and the specificity of SLRT and Lasegue sign findings are higher. In these cases, they are the most critical sources of data together with MRI in determining the side where the surgical intervention will be performed.

ACKNOWLEDGMENTS

The author would like to thank Omer Asan and Nurhale Asan for their help in the preparation and design of the manuscript and translator Irem Nur Onay.

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Conflict of interest statement: No external funding was involved in the development of this study.

Received 27 February 2018; accepted 28 March 2018

Citation: World Neurosurg. (2018) 114:e1297-e1301. <https://doi.org/10.1016/j.wneu.2018.03.201>

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