The Essence of Clinical Practice Guidelines for Lumbar Disc Herniation, 2021: 3. Diagnosis

Takashi Kaito1 and Yu Yamato2

1) Department of Orthopaedic Surgery, Osaka University Graduate School of Medicine, Osaka, Japan
2) Department of Orthopaedic Surgery, Hamamatsu University School of Medicine, Shizuoka, Japan

Keywords:
Lumbar disc herniation, Diagnostics, Medical history, Symptoms, Physical findings, Diagnostic imaging, Auxiliary diagnostic procedure

This article is the third part of the five-article series, The Essence of Clinical Practice Guidelines for Lumbar Disc Herniation, published in the Spine Surgery and Related Research: Volume 6, Issue 4.

Summary

The disease name “lumbar disc herniation” may be used without careful consideration by patients based on subjective symptoms and by healthcare professionals on the basis of imaging data. In reality, however, it is difficult to diagnose that “lumbar disc herniation is the cause of clinical disorders” based solely on clinical symptoms, such as radiating pain in the lower legs, or imaging findings, such as lumbar disc herniation (including intervertebral disc bulging) on MRI. Moreover, diagnosis of the affected levels and damaged nerve roots on the basis of only clinical findings is not very accurate. This is attributable to many factors, such as the presence of a wide variety of pathological conditions manifested as radiating pain in the lower legs, morphological varieties of lumbar disc herniation (with/without extrusion, localization), and frequent detection of asymptomatic intervertebral disc herniation, particularly in elderly patients because of advances in image analyzers, such as MRI. Therefore, lumbar disc herniation/damaged nerve roots should be diagnosed comprehensively based on medical interviews, physical findings, and diagnostic imaging.

Commentary

1. Symptoms of lumbar disc herniation

Obtaining information suggestive of lumbar disc herniation from medical interviews, including history taking, is critical to effectively conduct subsequent diagnostic procedures based on physical findings/diagnostic imaging.

1.1. Manifestation patterns/patient background/symptoms

The diagnostic accuracy using ROC curves of four past medical histories is 0.8, and the usefulness of history taking has been reported1,2. Similarly, the diagnostic accuracy with ROC curves including past medical history and patient background is 0.653. Worsening of leg pain by coughing/sneezing/straining has also been reported to be a crucial symptom in medical history suggesting lumbar disc herniation4.

1.2. Duration of symptoms

The duration of preoperative symptoms in lumbar disc herniation has been reported to be shorter than that in spinal canal stenosis5. The noncontained type (transligamentous extrusion and sequestration) is associated with a higher pain intensity and shorter duration of symptoms compared with the contained type (protrusion and subligamentous extrusion). Thus, another consideration is required on the differences in symptoms by types of lumbar disc herniation6.

1.3. Characteristics of lumbar disc herniation in young patients

Corresponding author: Takashi Kaito, takashikaito@ort.med.osaka-u.ac.jp
Received: February 15, 2022, Accepted: March 12, 2022
Copyright © 2022 The Japanese Society for Spine Surgery and Related Research
Low back pain, severely limited trunk forward bending, tight hamstrings, and sciatic scoliosis are characteristic findings in young patients with lumbar disc herniation\(^\text{11-14}\).  

2. Clinical diagnosis of lumbar disc herniation  

Diagnosing lumbar disc herniation is a process comprising the identification of nerve roots damaged by exposure to physical/chemical stimuli from the herniated disc and differentiation from other pathological conditions manifested as similar disorders. In the case of single-level radiculopathy, nerve root compression in the lumbar spine can be at the intraspinal canal at the level where the affected nerve root diverges or intra/extraforaminal at one level below, and the consistency among diagnostic findings, including medical history/physical examination and imaging findings, such as MRI should be verified. In MRI-based diagnosis, the prevalence of asymptomatic lumbar disc herniation (bulging) is high, and dependence on diagnostic imaging alone should be avoided\(^\text{20}\).

2.1. Diagnostic accuracy of various tests/physical examination  

Pain provocation test  

The straight leg raising test (SLRT) is highly positive, particularly in young patients with lumbar disc herniation. The test has been shown to be useful for the diagnosis of lumbar disc herniation. However, the specificity was reported to be low (sensitivity 0.35-0.97, specificity 0.10-1.00)\(^\text{11}\). This may be attributable to the differences in the definition of a positive test result between the reports, presence of various spinal diseases that can cause nerve root compression, and lack of standardization of terms. In contrast, the femoral nerve stretching test and crossed SLRT have been reported to have high specificity, albeit low sensitivity\(^\text{11}\).

Muscle weakness/sensory disturbance  

Regarding the diagnostic accuracy of muscle weakness, the specificity has been reported to be moderate in patients with severe paralysis, albeit the sensitivity is low. In contrast, regarding the diagnostic accuracy of sensory disturbance, several reports have shown that both sensitivity and specificity are low\(^\text{11-15}\).

Absent/diminished deep tendon reflex  

Patients are considered positive for L4 radiculopathy and S1 radiculopathy if the patellar tendon reflex and Achilles tendon reflex is diminished or absent, respectively; however, both of them have been reported to have low diagnostic accuracy\(^\text{11-15}\).

Pain radiation area (patient-reported)  

Some reports have concluded that the distribution of radiating pain is diagnostically useful\(^\text{16}\). Meanwhile, this information is not useful for differential diagnosis between L5 and S1 radiculopathy\(^\text{17}\).

2.2. Comprehensive diagnosis with medical history and various physical findings  

The diagnostic accuracy is improved by the combined use of medical history and various examinations in a comprehensive manner since each of the diagnostic procedures has a low diagnostic accuracy for lumbar disc herniation when used alone\(^\text{11-16}\).

3. Diagnostic imaging for lumbar disc herniation (plane radiography, MRI, CT, including diagnostic value and necessity)  

While MRI is the first-line imaging procedure, myelography or CT can be used as an alternative in patients for whom MRI cannot be used. For special pathological conditions, imaging procedures appropriate for a condition of interest should be performed. A systematic review has concluded that CT, myelography, and MRI have comparable diagnostic accuracies as follows: CT (nine studies), mean diagnostic rate 72%; myelography (eight studies), mean diagnostic rate 69.2%; and MRI (six studies), mean diagnostic rate 68.9%\(^\text{18}\).

3.1. MRI  

An analysis of preoperative MRI for the subligamentous and transligamentous types has shown that the sensitivity, specificity, and accuracy of morphological diagnosis were all \~76% when significant findings were used in combination\(^\text{20}\). MRI used to differentiate the contained and noncontained types showed sensitivity, specificity, and accuracy of 72%, 68%, and 70%, respectively\(^\text{20}\). The inter-rater reliability of MRI was not high\(^\text{21,22}\). Moreover, MRI detects asymptomatic lumbar disc herniation\(^\text{23}\). Recently, the usefulness of MRI in the sitting position and dynamic MRI for diagnostic imaging have been reported\(^\text{24,25}\).

3.2. CT  

In a systematic review studying the accuracy of CT-based diagnosis of lumbar disc herniation, the sensitivity and specificity were found to be 77.4% and 73.7%, respectively\(^\text{26}\). Among patients who underwent surgery, MRI and CT were used for diagnostic imaging; there were no differences between CT and MRI in the diagnostic accuracy of lumbar disc extrusion\(^\text{27}\). Myelography followed by CT was reported to be advantageous and useful for patients who could not undergo MRI\(^\text{28}\).

3.3. Plain radiography  

Plain radiography has significance when the clinical course and clinical symptoms suggest other nondegenerative pathology.
4. Auxiliary diagnosis for identification of affected levels/nerve roots and significance thereof

No single auxiliary diagnostic procedure can perform the level diagnosis nor identify the damaged nerve root independently with a high diagnostic accuracy; however, selective nerve root block is useful when damaged nerve roots cannot be determined. Imaging procedures and electrophysiological investigations should be combined with past medical history and physical examinations for comprehensive diagnosis.

4.1. Neurophysiological investigations

Neurophysiological investigations alone showed low sensitivity and specificity in the diagnosis of damaged nerve roots. The combined use of MRI and neurophysiological investigations was effective for the diagnosis of damaged nerve roots.

4.2. MRI

Diffusion tensor imaging analysis was used to quantitatively evaluate nerve root damage due to lumbar disc herniation and may have the potential to visualize microstructural changes in compressed nerve roots.

4.3. Selective nerve root block

Although no reliable reports are available on the diagnostic accuracy of selective nerve root block, this method is useful when the damaged nerve roots cannot be determined otherwise.

Conclusions

No single diagnostic technology or method has sufficient sensitivity and specificity for independent and direct diagnosis of lumbar disc herniation. Therefore, integrated decision-making based on relevant data/information, such as proper medical interviews, patient background, physical findings, and imaging findings, in a comprehensive manner is critical for diagnosis.

Conflicts of Interest: The authors declare that there are no relevant conflicts of interest.

The original version of these clinical practice guidelines appeared in Japanese as Yotsui Tsuikanban Hernia Shinryo Guidelines 2021, and its translated version in English was published in the Journal of Orthopaedic Science: Japanese Orthopaedic Association (JOA) clinical practice guidelines on the management of lumbar disc herniation, third edition. 2022;27(1): 31-78.

References

1. Vroomen PC, De Krom MC, Knotterus JA. Diagnostic value of history and physical examination in patients suspected of sciatica due to disc herniation: a systematic review. J Neurol. 1999;246 (10):899-906.

2. Vroomen PC, De Krom MC, Wilming JT, et al. Diagnostic value of history and physical examination in patients suspected of lumbo-sacral nerve root compression. J Neurol Neurosurg Psychiatry. 2002;72(5):630-4.

3. Verwoerd AJ, Peul WC, Willemsen SP, et al. Diagnostic accuracy of history taking to assess lumbo-sacral nerve root compression. Spine J. 2014;14(9):2028-37.

4. Verwoerd AH, Mens J, El Bazrouhi A, et al. A diagnostic study in patients with sciatica establishing the importance of localization of worsening of pain during coughing, sneezing and straining to assess nerve root compression on MRI. Eur Spine J. 2016;25(5):1389-92.

5. Jonsson B, Stromqvist B. Symptoms and signs in degeneration of the lumbar spine. A prospective, consecutive study of 300 operated patients. J Bone Joint Surg Br. 1993;75(3):381-5.

6. Nakagawa H, Kaminura M, Takahara K, et al. Optimal duration of conservative treatment for lumbar disc herniation depending on the type of herniation. J Clin Neurosci. 2007;14(2):104-9.

7. Lavelle WF, Bianco A, Mason R, et al. Pediatric disc herniation. J Am Acad. Orthop Surg. 2011;19(11):649-56.

8. Epstein JA, Epstein NE, Marc JO, et al. Lumbar intervertebral disk herniation in teenage children: recognition and management of associated anomalies. Spine. 1984;9(4):427-32.

9. Zhu Z, Zhao Q, Wang B, et al. Scoliotic posture as the initial symptom in adolescents with lumbar disc herniation: its curve pattern and natural history after lumbar discectomy. BMC Musculoskelet Disord. 2011;12(1):216.

10. Boden SD. The use of radiographic imaging studies in the evaluation of patients who have degenerative disorders of the lumbar spine. J Bone Joint Surg Am. 1996;78(1):114-24.

11. van der Windt DA, Simons E, Riphagen II, et al. Physical examination for lumbar radiculopathy due to disc herniation in patients with low-back pain. Cochrane Database Syst Rev. 2010;(2):CD 007431.

12. Hancock MJ, Koes B, Ostelo R, et al. Diagnostic accuracy of the clinical examination in identifying the level of herniation in patients with sciatica. Spine. 2011;36(11):E717-9.

13. Tawa N, Rhoda A, Diener I. Accuracy of clinical neurological examination in diagnosing lumbo-sacral radiculopathy: a systematic literature review. BMC Musculoskeletal Disord. 2017;18(1):93.

14. Iversen T, Solberg TK, Ronner B, et al. Accuracy of physical examination for chronic lumbar radiculopathy. BMC Musculoskeletal Disord. 2013;14(1):206.

15. Al Nezari NH, Schneider AG, Hendrick PA. Neurological examination of the peripheral nervous system to diagnose lumbar spinal disc herniation with suspected radiculopathy: a systematic review and meta-analysis. Spine J. 2013;13(6):657-74.

16. Tawa N, Diener I, Louw Q, et al. Correlation of the self-reported Leeds assessment of neuropathic symptoms and signs score, clinical neurological examination and MR imaging in patients with lumbo-sacral radiculopathy. BMC Neurol. 2019;19(1):107.

17. Taylor CS, Coxon AJ, Watson PC, et al. Do L5 and s1 nerve root compressions produce radicular pain in a dermatomal pattern? Spine. 2013;38(12):995-8.

18. Kim JH, van Rijn RM, van Tulder MW, et al. Diagnostic accuracy of diagnostic imaging for lumbar disc herniation in adults with low back pain or sciatica is unknown; a systematic review. Chiropr Man Therap. 2018;26(1):37.

19. Oh KJ, Lee JW, Yun BL, et al. Comparison of MR imaging findings between extraligamentous and subligamentous disk herniations in the lumbar spine. AJNR Am J Neuroradiol. 2013;34(3):683-7.
20. Weiner BK, Patel R. The accuracy of MRI in the detection of lumbar disc containment. J Orthop Surg Res. 2008;3(1):46.
21. El Barzouhi A, Vleggeert-Lankamp CL, Lycklama à Nijeholt GI, et al. Magnetic resonance imaging interpretation in patients with sciatica who are potential candidates for lumbar disc surgery. PLoS One. 2013;8(7):e68411.
22. Kim SW, Yeom JS, Park SK, et al. Inter- and intra-observer reliability of MRI for lumbar lateral disc herniation. Clin Orthop Surg. 2009;1(1):34-9.
23. Kanayama M, Togawa D, Takahashi C, et al. Cross-sectional magnetic resonance imaging study of lumbar disc degeneration in 200 healthy individuals. J Neurosurg Spine. 2009;11(4):501-7.
24. Gilbert JW, Martin JC, Wheeler GF, et al. Lumbar disk protrusion rates of symptomatic patients using magnetic resonance imaging. J Manipulative Physiol Ther. 2010;33(8):626-9.
25. Zou J, Yang H, Miyazaki M, et al. Missed lumbar disc herniations diagnosed with kinetic magnetic resonance imaging. Spine. 2008;33(5):E140-4.
26. van Rijn RM, Wassenaar M, Verhagen AP, et al. Computed tomography for the diagnosis of lumbar spinal pathology in adult patients with low back pain or sciatica: a diagnostic systematic review. Eur Spine J. 2012;21(2):228-39.
27. Moranjkic M, Ercegovic Z, Hodzic M, et al. Diagnostic characteristics of neuroradiological tests in lumbar disc herniation. Acta Medica Saliniana. 2011;40(1):1-6.
28. Park CK, Lee HJ, Ryu KS. Comparison of root images between post-myelographic computed tomography and magnetic resonance imaging in patients with lumbar radiculopathy. J Korean Neurosurg Soc. 2017;60(5):540-9.
29. Wojtysiak M, Huber J, Wiertel-Krawczuk A, et al. Pre- and post-operative evaluation of patients with lumbosacral disc herniation by neurophysiological and clinical assessment. Spine. 2014;39(21):1792-800.
30. Zhong W, Wang J, Zhang W, et al. Combination of magnetic resonance imaging and electrophysiological studies in lumbar disc herniation. Acta Neurochir Suppl. 2017;124:271-5.
31. Wu W, Liang J, Ru N, et al. Microstructural changes in compressed nerve roots are consistent with clinical symptoms and symptom duration in patients with lumbar disc herniation. Spine. 2016;41(11):E661-6.
32. He A, Wang WZ, Qiao PF, et al. Quantitative evaluation of compressed L4-5 and S1 nerve roots of lumbar disc herniation patients by diffusion tensor imaging and fiber tractography. World Neurosurg. 2018;115:e45-52.
33. Chuanting L, Qingzheng W, Wenfeng X, et al. 3.0T MRI tractography of lumbar nerve roots in disc herniation. Acta Radiol. 2014;55(8):969-75.
34. Kikuchi S, Matsui T, Hoshika I, et al. Diagnostic and therapeutic limits of lumbosacral nerve root infiltration. Seikei Saigai Geka (Orthopaedic Surgery and Traumatology). 1984;27:1897-904 (in Japanese).
35. Fukuda F, Hijioka A, Narusawa K, et al. The sensitivity of clinical and imaging findings in lumbar disc herniation. Seikei Saigai Geka (Orthopaedic Surgery and Traumatology). 2001;44(7):875-8 (in Japanese).