Lumbar Foraminal Stenosis Magnetic Resonance Imaging Classification

- GPT4LFS (generative pretrained transformer 4 omni for lumbar foramina stenosis): enhancing lumbar foraminal stenosis image classification through large multimodal models
- MRI evaluation of lumbar foraminal stenosis: correlation between a new quantitative evaluation and the qualitative Lee's classification
- Inter-observer variability in the classification of lumbar foraminal stenosis in magnetic resonance imaging using different evaluation scales
- Relationship Between Lumbar Foraminal Stenosis and Multifidus Muscle Atrophy: A Retrospective Cross-Sectional Study
- Value of chemical shift imaging in the evaluation of neural foramen stenosis
- In subjects with chronic low back pain, does neuropathia exclusively correlated to neuronal compression? A correlation study of PainDETECT questionnaire and corresponding MRI and X-ray findings
- A neural network model for detection and classification of lumbar spinal stenosis on MRI
- A new comprehensive MRI classification and grading system for lumbosacral central and lateral stenosis: clinical application and comparison with previous systems

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Lee classification

Lee classification for Lumbar Foraminal Stenosis.

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see Lumbar Foraminal Stenosis Classification.

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see also Foraminal Stenosis Magnetic Resonance Imaging Classification.

The MRI grading systems are a useful tool that allows lumbar foraminal stenosis to be evaluated more objectively. For Grade 3, surgical treatment can be considered over conservative treatment. However, the MRI grading system alone is less reliable for symptomatic, L5-S1 foraminal stenosis, as indicated by a lower margin of agreement in operated neuroforamens than in other levels. Therefore, various clinical factors as well as an MRI grading system are required for surgical decision-making [1)]

Foraminal stenotic ratio

Foraminal stenotic ratio was defined as the ratio of the length of the stenosis to the length of the foramen on the reconstructed oblique coronal image, referring to perineural fat obliterations in whole oblique sagittal images. They also evaluated the foraminal nerve angle and the minimum nerve diameter on reconstructed images, and the Lee classification on conventional T1 images. The FSR determined LFS requiring surgery among symptomatic patients, with moderate accuracy. Foramina occupied ≥50% by fat obliteration were likely to fail conservative treatment, with a positive predictive value of 75% [2].

Sartoretti Classification

https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8184791/

Using high-resolution imaging which also allows for a reduction in partial volume effects as compared to the original thick 2D sagittal images, a much more complex relationship between the nerve root and the surrounding structures within the foramen can be identified. To this extent, an updated classification scheme has been developed in an effort to more accurately describe lumbar foraminal stenosis as seen on high-resolution imaging. This updated scheme builds on the original Lee grading system but is more detailed and accurately describes even the smallest anatomical changes in the lumbar foramen that would not have been visible on the original 2D sequences

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The grading system was developed primarily based on a 3D sagittal high-resolution T2-weighted (T2w) sequence and secondarily on a 2D T1-weighted (T1w) sequence

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The original Lee classification considers contact between nerve root and the surrounding structures in anterior and posterior transverse and in superior and inferior vertical direction due to disc space narrowing, discoosteophytic protrusions, thickened ligamentum flavum and facet arthropathy followed by nerve root collapse or morphologic nerve root change. Thus, contact of the nerve root with the surroundings is possible at 4 different nerve root positions i.e. superior, posterior, inferior and anterior border. Superior contact is between nerve root and floor of the pedicle of the upper vertebra of the corresponding segment. Posterior contact is given by the ligamentum flavum and the osseous facet joint and the inferior articular process. Inferior contact is due to posterior protrusion of the intervertebral disc and adjacent osteophytes. Anterior contact is given by the posterior inferior border of the vertebral body inferior to the pedicle.

Ther grading system is based on static sagittal MR images without symptomatic correlation. Specifically, clinical symptoms may arise only with dynamic changes, such as lumbar extension, which cannot be provoked or detected in a closed MR system. Furthermore they primarily used 3D T2w images for grading because this sequence could be acquired (nearly isotropic) in high resolution at a reasonable scan time with the possibility to get curved transverse and coronal reconstructions. T1w images may be preferred at other institutions due to the high contrast between fat and the surrounding tissues. However, a high contrast between fat and surrounding tissues was also achieved in 3D T2w sequence [3].

Kunogi and Hasue classification

The classification of lumbar foraminal stenosis proposed by Kunogi and Hasue [4] included the anteroposterior, cephalocaudal, and circumferential types without stenosis grade.

Wildermuth classification

The grading system suggested by Wildermuth et al. [5] focused on only the degree of epidural fat obliteration.

Varghese and Babu classification

Varghese B, Babu AC. An analysis on reliability of the lee and wildermuth magnetic resonance imaging grading systems for lumbar neural foraminal stenosis. West Afr J Radiol [serial online] 2017 [cited 2022 May 9];24:8-13. Available from: https://www.wajradiology.org/text.asp?2017/24/1/8/192750

Varghese and Babu proposed a new grading system by modifying the Wildermuth system, for daily radiological reporting.

1)
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2)
Yamada K, Abe Y, Satoh S, Yanagibashi Y, Hyakumachi T, Masuda T. A novel diagnostic parameter, foraminal stenotic ratio using three-dimensional magnetic resonance imaging, as a discriminator for surgery in symptomatic lumbar foraminal stenosis. Spine J. 2017 Aug;17(8):1074-1081. doi: 10.1016/j.spinee.2017.03.010. Epub 2017 Mar 30. PMID: 28366688.
3)
Sartoretti E, Wyss M, Alfieri A, Binkert CA, Erne C, Sartoretti-Schefer S, Sartoretti T. Introduction and reproducibility of an updated practical grading system for lumbar foraminal stenosis based on high-resolution MR imaging. Sci Rep. 2021 Jun 7;11(1):12000. doi: 10.1038/s41598-021-91462-2. Erratum in: Sci Rep. 2021 Sep 15;11(1):18732. PMID: 34099833; PMCID: PMC8184791.
4)
Kunogi J, Hasue M. Diagnosis and operative treatment of intraforaminal and extraforaminal nerve root compression. Spine 1991; 16:1312–1320
5)
Wildermuth S, Zanetti M, Duewell S, Schmid MR, Romanowski B, Benini A, et al. Lumbar spine: Quantitative and qualitative assessment of positional (upright flexion and extension) MR imaging and myelography. Radiology. 1998;207:391-98