#950 - Posters

An Automated Two-Stage Deep Learning Framework For Cervical Spinal Stenosis Diagnosis From Sagittal MRI

Orthopaedics / Spine / Epidemiology, Prevention & Diagnosis

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Keywords: Cervical Spinal Stenosis, Deep Learning, Magnetic Resonance Imaging, Object Detection, Image Classification, Automated Diagnosis

Background
Artificial intelligence (AI) in medicine has gained popularity owing to its high-precision and time-saving capabilities. AI has the potential to assist doctors in accomplishing repetitive and time-consuming tasks such as reading multiple medical images and automatically identifying medically relevant indicators.

Objectives
Manual grading of cervical spinal stenosis (CSS) from MRI scans is time-consuming and susceptible to significant inter- and intra-observer variability. This study presents an automated deep learning system to accurately localize cervical disc levels and provide reliable CSS grades at the patch, image, and subject levels.

Study Design & Methods
A dataset of 439 sagittal T2-weighted MRI scans from 200 patients was initially collected with IRB approval. Our framework first employs a YOLOv5 model to automatically localize the five primary cervical intervertebral discs (C2-C3 to C6-C7) and extract disc patches. After a quality control step excluded 56 images, 1,915 patches from 383 images (184 patients) were retained. Subsequently, a Swin-Tiny transformer model classified each patch into a stenosis grade (0-3).

Results
In patch-level 4-class classification, the model achieved an overall accuracy of 80.73% and a high recall of 94.36% for Grade 0 (no stenosis). For the subject-level binary screening task (Grade 0 vs. Grades 1-3), the framework achieved an accuracy of 92.39%. Critically, it demonstrated a high sensitivity of 95.89% for detecting the presence of stenosis, corresponding to a low false-negative rate (4.11%).

Conclusions
Our fully automated pipeline provides an objective, efficient methodology for disc localization and CSS grading. Given its high sensitivity and accuracy, this framework shows significant promise as a robust clinical screening tool. It can effectively assist clinicians in prioritizing patients and optimizing the diagnostic workflow.

Created on 13.11.2025 07:53:00