BP-11

Pathology-guided ai system for accurate segmentation and diagnosis of degenerative cervical myelopathy

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Background: Accurate diagnosis of DCM is essential but challenging, as manual interpretation of cervical spine MRI is labor-intensive, time-consuming, and prone to error. While effective in specific tasks like anatomical segmentation or limited diagnostic evaluations, current deep learning models lack the comprehensive functionality necessary for clinical applications.

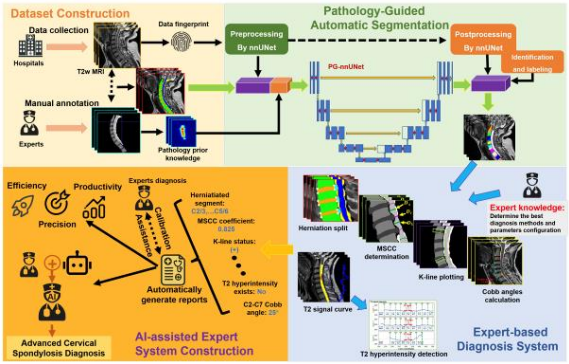
Methods: Using a dataset of 960 T2-weighted cervical MRI images from patients diagnosed with cervical disc herniation, our system employs a novel deep learning model, PG-nnUNet, to enhance the accuracy and interpretability of both segmentation and diagnosis. For diagnostic evaluation, our system extracts clinically relevant indicators from the segmentation results, including the C2-C7 Cobb angle, Maximum Spinal Cord Compression (MSCC) coefficient, K-line assessment (±), herniation localization, and T2 hyperintensity detection. For T2 hyperintensity detection, commonly indicative of spinal cord pathology, we introduced a novel indicator, the Relative Signal Change Index (RSCI).

Results: PG-nnUNet achieved state-of-the-art segmentation performance across all targeted anatomical structures, with Dice coefficients exceeding 0.94 for vertebral bodies and spinal cord, and 0.83 for cerebrospinal fluid, underscoring its high accuracy and suitability for clinical use. The model outperformed other leading deep learning architectures, including CNN-based and Transformer-based models, particularly in challenging tasks like segmenting small, complex pathological areas. Diagnostic precision was also notably high and showed excellent concordance with expert measurements.

Discussion: We present an AI-assisted, expert-guided system that advances both the automation and accuracy of cervical spondylosis diagnosis.

Figure 1: Graphic Abstract

Fig. 1


Dataset Construction
Data collection
Hospitals
Data fingerprint
T2w MRI
Manual annotation
Experts
Pathology prior knowledge
Pathology-Guided Automatic Segmentation
Preprocessing By nnUNet
PG-nnUNet
Postprocessing By nnUNet
Identification and labeling
Efficiency
Productivity
Precision
Experts diagnosis
Calibration
Assistance
Automatically generate reports
Herniated segment:
MSCC coefficient:
K-line status:
T2 hyperintensity exists:
C2-C7 Cobb angle:
Advanced Cervical Spondylosis Diagnosis
AI-assisted Expert System Construction
Hernation split
MSCC determination
K-line plotting
Cobb angles calculation
T2 signal curve
T2 hyperintensity detection
Expert knowledge:
Determine the best diagnosis methods and parameters configuration
Expert-based Diagnosis System