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An Artifical Intelligence (AI) Boost to MRI Lumbar Spine Reporting

Category: Quality Improvement Reports

- Informatics and Technology, including Artificial Intelligence (AI) -

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Conflict of Interest Disclosure:

This study was performed in collaboration with CoLumbo, a subsidiary of Smart Soft Healthcare based in Bulgaria, on the AI orchestration platform, CARPL.AI, based in the United States.

Introduction

- Lumbar spine MRI is commonly performed for back pain assessment.
- The interpretation involves grading spinal stenosis at multiple levels, which is repetitive and time-consuming.
- Machine learning algorithms are postulated to improve reporting productivity while maintaining consistency.
- Aims: To assess reporting speed and diagnostic accuracy with and without assistance from an artificial intelligence (AI) reading assistive tool.

Methods

Data Set

- n=31, randomly selected MRI lumbar spine, age 18 to 80
- 1 to 10 Dec 2022 at a single tertiary center
- Exclusion criteria: Patients with instrumentation and scoliosis

AI Assisted Interpretation

- DICOM* data were processed by deep learning-based solution on an AI orchestration platform, with provision of:
  - Pathology descriptions, measurements and annotations.
  - Editable auto-generated reports tailored to the department reporting format.

**DICOM - Digital Imaging and Communications in Medicine*

Methods

Study Design

- Comparison of performance between 4 Radiologists and 3 Radiology residents.

Radiologists	Residents
4 board-certified Musculoskeletal and Neuroradiologists, with ≥8 years of specialist experience each.	3 final year radiology residents, blinded to the original reports.
Reporting without AI assistance.	Reporting with AI assistance.
Reporting time = time taken to verify the radiology reports, extracted from RIS* logs.	Reporting time = time taken to read scans and addend pre-populated reports.

Statistical Analysis

- A paired t-test was performed for calculation of statistical significance.

**RIS - radiology information system*

Results

	Radiologists (without AI Assistance)	Residents (with AI Assistance)	Comments
Mean Interpretation Time (min)	22.44 ± 10.90	8.47 ± 3.77	p<0.001
Interquartile range, IQR (min)	14.15	4.78	Smaller IQR indicates more consistent interpretation times with AI assistance.
Mean Difference = -13.97 minutes (95% CI: -16.66 to -11.28), $p < 0.001$.			
Diagnostic accuracy (stenosis grading & incidental findings) was not significantly different between the two groups.			

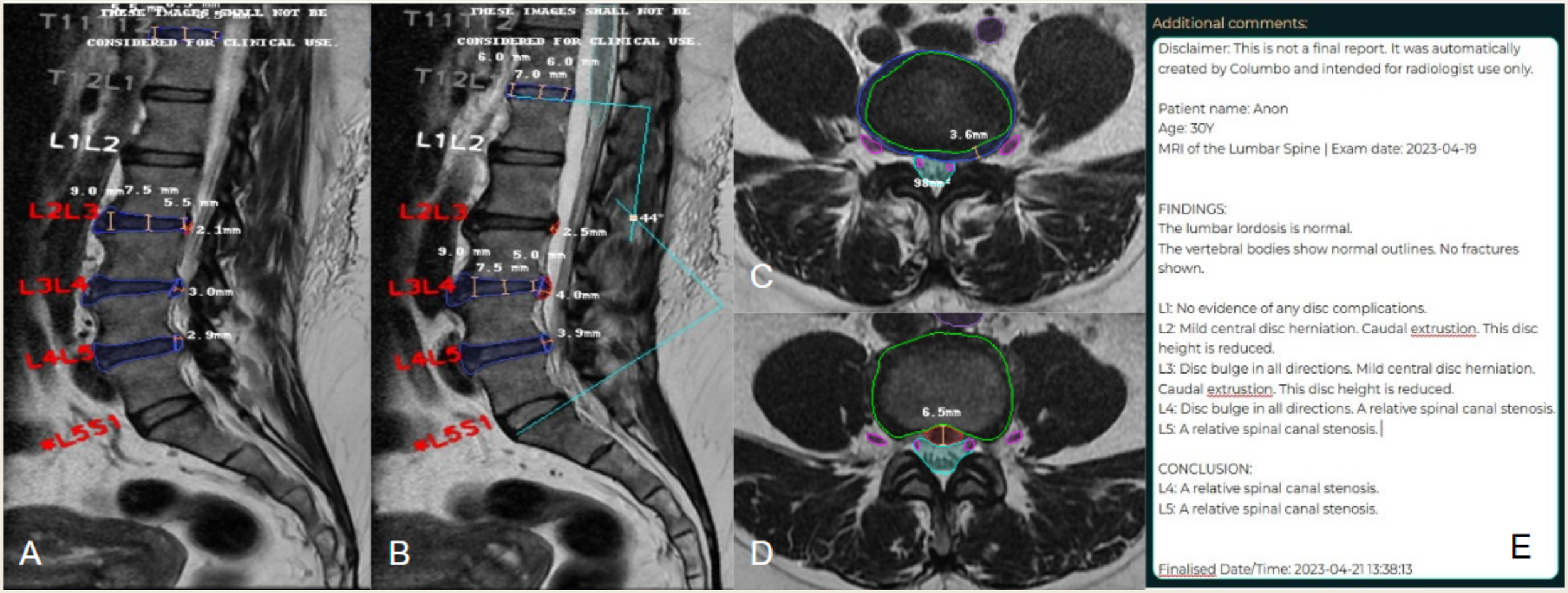
Discussion

- Limitations:
  - Radiologists may experience interruptions (calls, attend to clinical responsibilities), prolonging reporting times.
  - In contrast, residents were given designated sessions for reporting.
  - Small sample size; larger datasets would be beneficial for validation.
  - AI occasionally mislabels the level in cases of sacralisation or lumbarisation.
  - While the AI accurately identifies severe stenosis, it tends to either overestimate or underestimate the severity of mild and moderate stenosis in the lamina recess and nerve root regions in some cases.

Discussion

- Future plans:
  - Prospective double blinded studies among radiologists with and without AI assistance
    - Additional work.
    - Ethical considerations (reporting discrepancy & quality).
  - Impact on health economic
    - time saving = more cost-efficient?
  - Shorter scan time.
    - Potentially fast sequences suffice for interpretation with AI.
  - Effect on resident education, more dependent on AI.
  - AI drift and software update.

Figure



Selected sagittal (A, B) and axial (C, D) slices through the lumbar spine demonstrate the AI analysis of spinal canal stenosis and disc complications at the levels where findings are more pronounced. A sample output report is then automatically generated detailing the findings at the various spinal levels (E).

Conclusion

AI assistance for MRI lumbar spine reporting resulted in significant reduction in reporting time with equivalent diagnostic accuracy compared to experienced radiologists without AI assistance.

With a larger sample size in future study, refined AI detection and reporting capabilities, we envision that AI integration will be a valuable complement to MRI lumbar spine reporting.