CENTER FOR BIOSYSTEMS AND BIOTECH DATA SCIENCE
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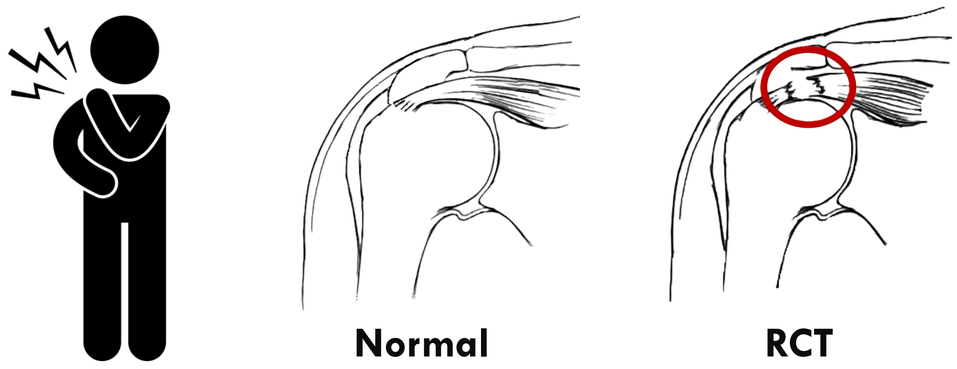
USING CAMSCORE AND SHAP FOR INTERPRETABLE ROTATOR CUFF TEAR DIAGNOSIS IN MRI SLIDES

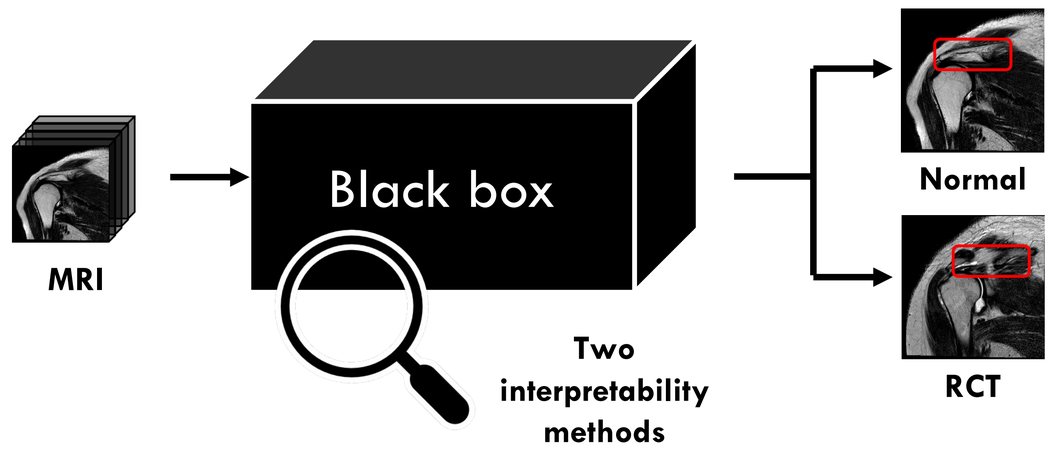
INTRODUCTION

Rotator Cuff Tears (RCTs)



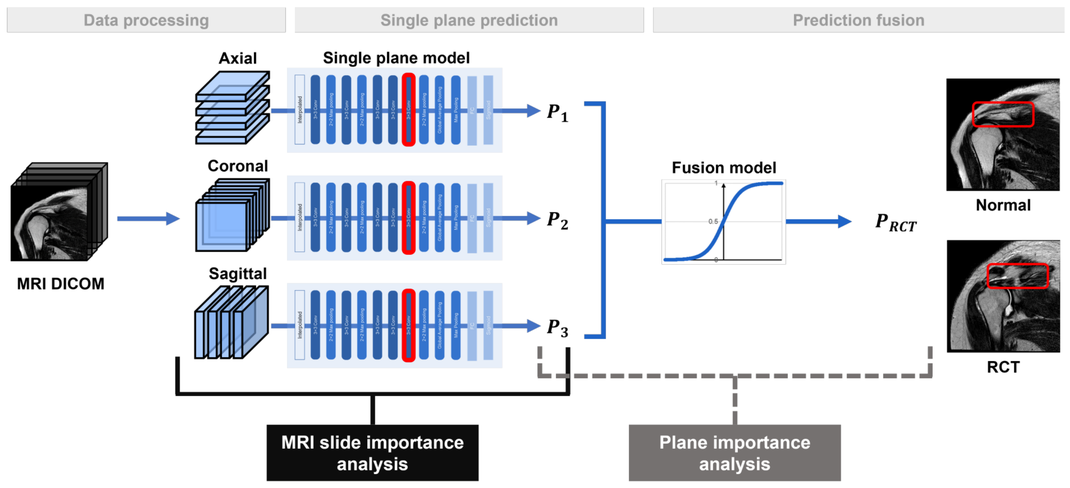
- RCTs are tears in the rotator cuff tendons of the shoulder, causing pain and limiting arm movement.
- Common in the elderly, RCTs are diagnosed via MRI and can require physical therapy or surgery.

What we did



- AI models for medical diagnosis are complex and lack transparency.
- We use two interpretability methods to analyze MRNet-based AI models.
- Our goal is to increase the trustworthiness of medical AI models.

METHODS



Two interpretability methods

Plane-level interpretability: CAMscore and CAM

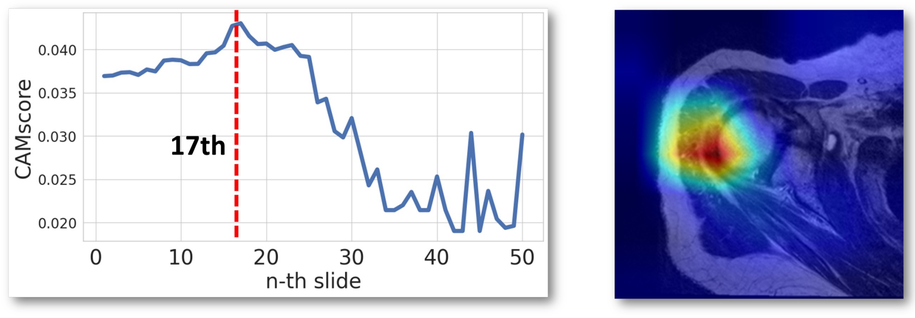
- We employ CAM (Class Activation Mapping) to identify regions in MRI slides that substantially influence AI-driven diagnosis.
- Additionally, we propose CAMscore as a means to determine the specific index of the slide that guides the AI model to its diagnosis.

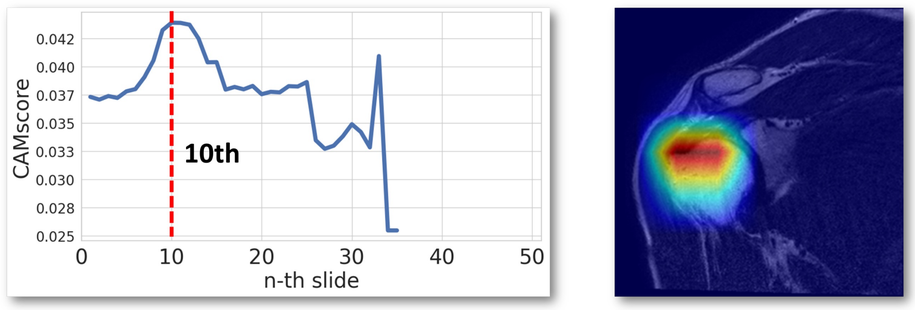
Fusion-level interpretability: SHAP

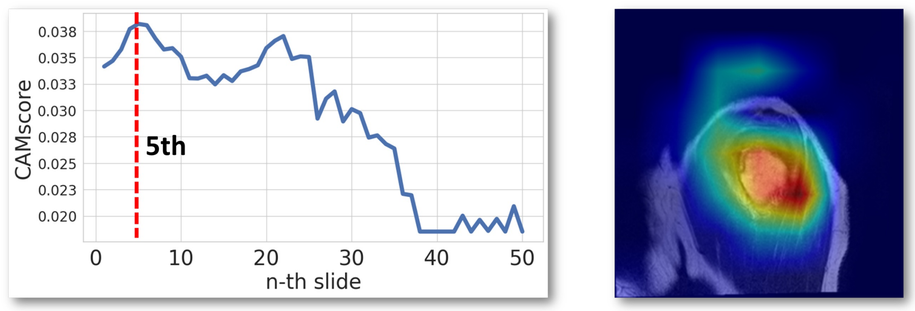
- To dissect the output of AI models, we utilize SHAP values, which provide insight into the contribution of each MRI plane to the diagnosis.

RESULTS

Plane-level interpretability: CAMscore and GradCAM







- The CAMscore plots for the axial, coronal, and sagittal planes show peak scores on the 17th, 10th, and 5th slides, respectively.
- Example CAM slides reveal that the models emphasize areas near the rotator tendon, pointing to regions that are key for diagnosis.
- The CAMscore plots and the example CAM slides highlight the diagnostic importance of specific MRI slides in identifying rotator cuff tears.

CONCLUSIONS

Summary

- Our study diverges from earlier studies that focused solely on the coronal plane as we investigate all shoulder MRI planes.
- Our fusion and sagittal models excel in diagnosing RCTs, as evidenced by their high F1-scores, showcasing their utility.
- Our CAMscore approach, derived from GradCAM, identifies slides crucial for RCT diagnosis.

Real-world applications

- We can extend our approach to other 3-D imaging techniques, such as Computational Tomography (CT), further enhancing the trustworthiness of AI models used for medical diagnosis.
- Our approach can be used to optimize diagnostic workflows, augmenting medical experts.

Limitations

- Further validation across diverse datasets is necessary as research findings are currently specific to one particular dataset.
- Refinement of the applicability of our AI models and future advancements will necessitate input from medical experts.
- Our anonymized dataset lacks detail, hindering the possibility of conducting in-depth, case-specific analyses.

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Additional information
Original paper