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Maximizing Signal in Minimal Space: Innovative Coil Pairing for Intraoperative MRI

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Introduction

Magnetic Resonance Imaging (MRI) is a widely used medical imaging modality that provides detailed anatomical and functional information for diagnosis due to the brilliant soft tissue contrast. In recent years, MR technology has rapidly expanded into additional areas. These include the radiation therapy, interventional and intraoperative practices. Due to various constraints of these additional uses, coils designed for routine diagnostic MRI might not be directly applicable to a variety of specialized radiation therapy, interventional and intraoperative MRI procedures. To date, few studies have explored the practicality of different coil combinations for the radiation therapy MRI, interventional and intraoperative MRI. Therefore, the purpose of this study is to investigate the feasibility and effects different coil combinations on image quality assessment compared to routine diagnosis coil setting.

Objectives

To investigate the clinical feasibility and image quality performance of different coil combinations in magnetic resonance imaging (MRI), with a focus on addressing spatial limitations in intraoperative MRI caused by the cranial fixator.

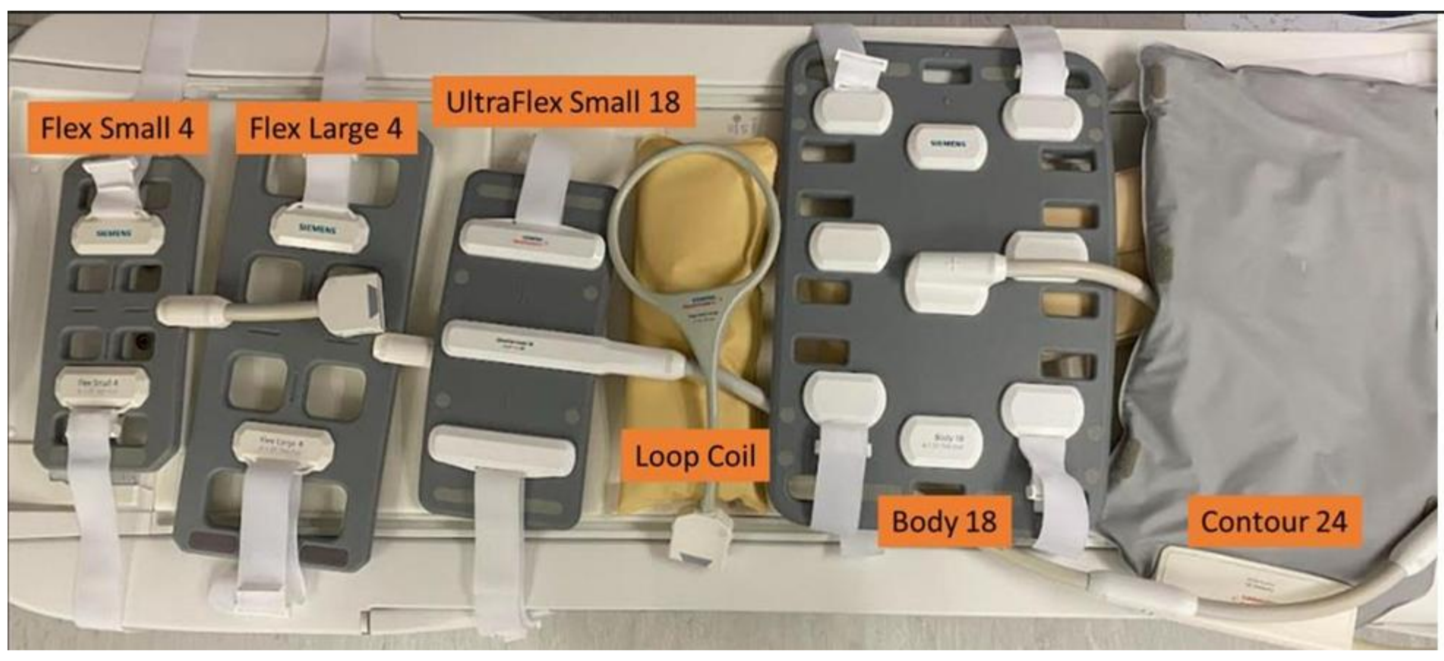
Methods

Various coil combinations were evaluated using ACR phantom measurements with T1- and T2-weighted spin-echo sequences. Key image quality metrics including signal-to-noise ratio (SNR), low contrast detectability, ghost artifacts, uniformity, penetration, and spatial resolution were quantitatively assessed using AutoQA software.

Representative intraoperative photographs will illustrate the practical setup and clinical application of this approach.

Results

All coil combinations demonstrated minimal ghost artifacts (<0.005). Spatial resolution matched the physical phantom setup across combinations. Notably, the combination of UltraFlex Small 18 with Contour 24 coils yielded the highest SNR, greatest image homogeneity, and superior low contrast detectability compared to other configurations and standard head coil imaging.

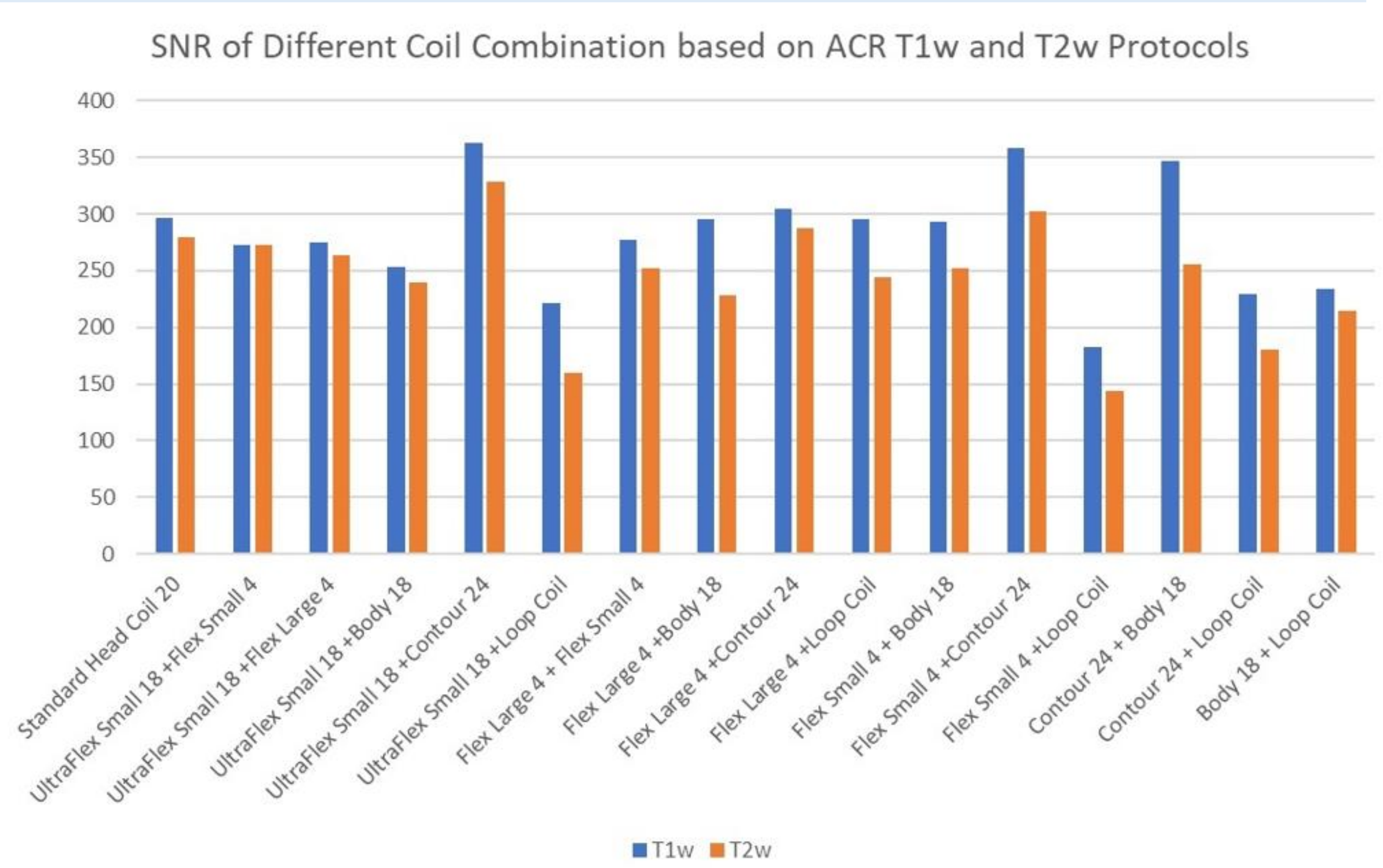


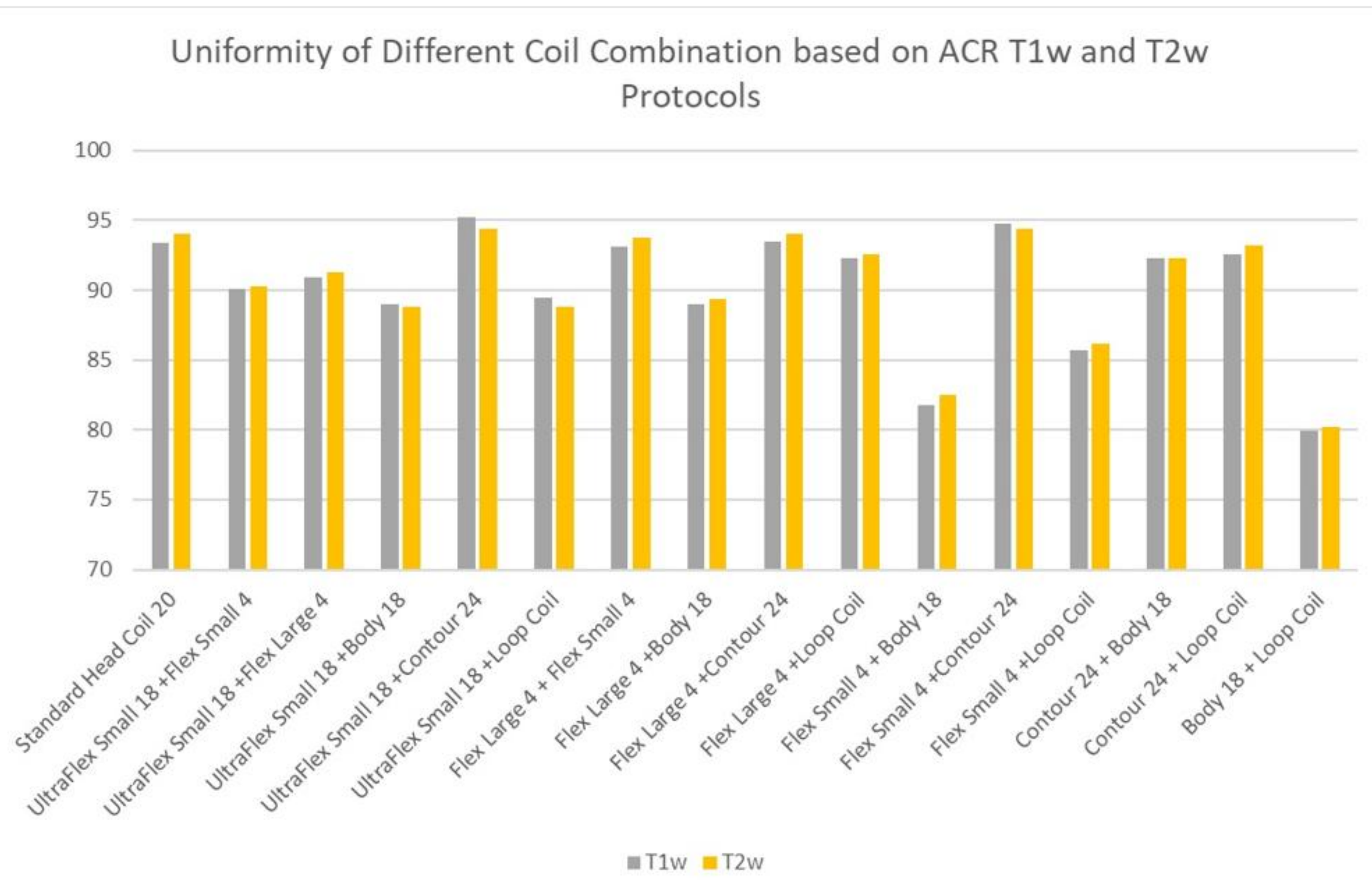
A

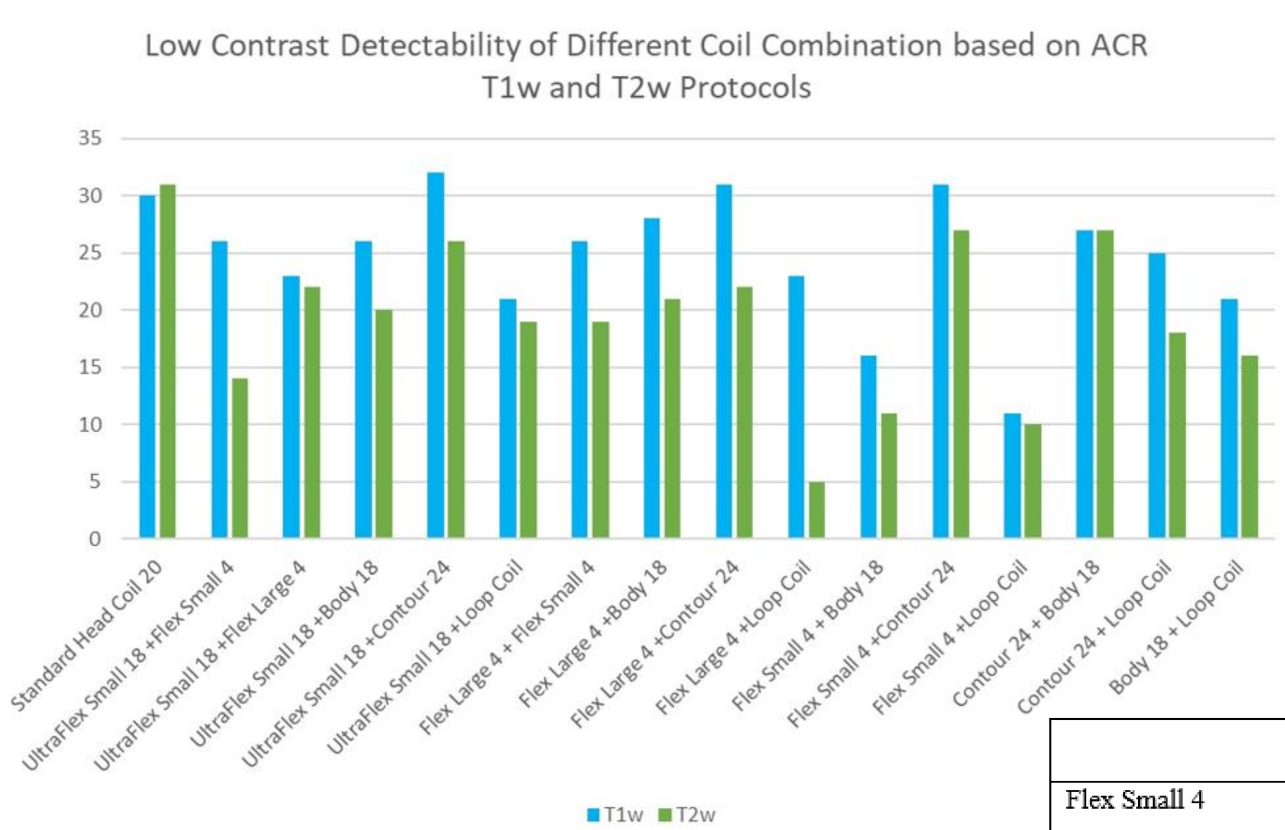
Coils available for intraoperative MRI set up

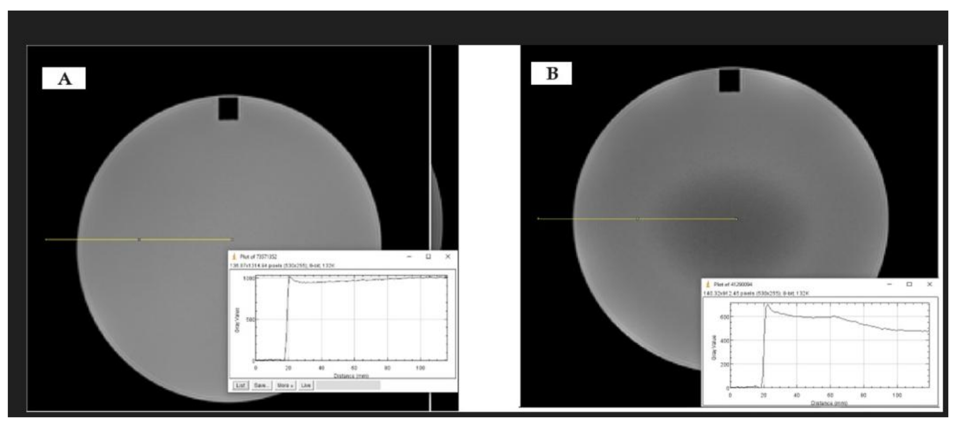
B

ACR phantom with coils surrounding it for image quality test









Uniformity

	Flex Small 4	Flex Large 4	Contour 24	UltraFlex Small 18	Body 18
Flex Small 4		OK	OK	OK	OK
Flex Large 4	OK		OK	OK	OK
Contour 24	OK	OK		OK	OK
UltraFlex Small 18	OK	OK	OK		OK
Body 18	OK	OK	OK	OK	
Loop 1.5T coil	OK	OK	OK	OK	OK

The potential coil combination for these may suitable to the radiation therapy MRI, interventional and intraoperative MRI

Conclusion

Flexible, compact coil combinations can deliver superior image quality in the intraoperative MRI setting despite the spatial constraints from the cranial fixator. These configurations enable reduced scan times and improved resolution while preserving surgical access, allowing precise interventions and smooth workflow.

References

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