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新技术在带来新机遇的同时，不可避免地面临着全新的挑战。在7.0 T及以上磁场强度的MRI临床应用中，射频脉冲波长随场强增加而缩短。7.0 T下的射频脉冲波长（11 cm）已小于正常头颅尺寸。这导致射频场（B1+）在小脑区域产生介电效应，减弱了脉冲信号。随着脑科学研究深入，小脑研究成为热点，不仅参与了运动控制，还与认知、语言、学习、记忆和情感等功能有关。7.0 T MRI以超高分辨率和信噪比推动了脑科学研究，但介电效应限制了其小脑研究和全脑临床应用。因此，改善小脑区域成像质量是7.0 T MRI面临的重要问题。

HDC材料的感应位移电流可以作为二次场源与主射频场叠加提升覆盖区域B1+场强度，增强7.0 T MRI中低信号区域的图像质量。近年来，$BaTiO_3$/$CaTiO_3$制备的HDC材料提高了7.0 T MRI小脑区域的BOLD图像质量，但其在常规序列中的性能提升仍未明确。

本研究使用7.0 T MRI对10名受试者进行扫描，先放置HDC垫，进行常规B1 map、T2WI-TSE、T1-mprage和DWI序列扫描；移除HDC垫后，重复上述序列作为对照组。采用Likert 5分量表主观评估和SNR客观评估方法，对比分析两次扫描的端脑和小脑图像质量。结果显示HDC垫可提升小脑成像质量，不影响端脑图像，为7.0 T MRI小脑疾病诊断及研究提供了新视野。详见内文第60页。

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About the cover

Although the advent of new technology introduces novel opportunities, it also inevitably encounters new challenges. In the clinical application of MRI with magnetic field intensities of 7.0 T and above, the wavelength of the RF pulse decreases as the field intensity increases. The RF pulse wavelength (11 cm) at 7.0 T is already smaller than the average skull size. This phenomenon causes the radio frequency field (B1+) to exhibit a dielectric effect in the cerebellar region, thereby weakening the pulse signal. As brain science research advances, the study of the cerebellum has emerged as a focal point, encompassing not only motor control but also cognitive functions, language, learning, memory, and emotions. While 7.0 T MRI has significantly advanced brain science research through its ultra-high resolution and signal-to-noise ratio, the dielectric effect has posed limitations on cerebellar research and whole-brain clinical applications. Consequently, enhancing the imaging quality of the cerebellar region is a critical challenge for 7.0 T MRI.

The induced displacement current of high dielectric constant (HDC) materials can serve as a secondary field source to augment the primary RF field, thereby increasing the B1+ field intensity in the target area and improving the image quality of low-signal regions in 7.0 T MRI. Recent studies using $BaTiO_3/CaTiO_3$-based HDC materials have demonstrated improvements in BOLD image quality in the cerebellar region of 7.0 T MRI, while its effectiveness in conventional sequences remains uncertain.

In this study, 7.0 T MRI was utilized to scan 10 subjects. Initially, the HDC pad was positioned, and routine B1 mapping, T2WI-TSE, T1-MPRAGE, and DWI sequences were conducted. Subsequently, after removing the HDC pad, the aforementioned sequences were repeated to serve as a control group. Both Likert 5-point scale subjective assessments and SNR objective assessments were employed to compare and analyze the image quality of the telencephalon and cerebellum from the two scans. The findings indicated that the HDC pad enhances cerebellar imaging quality without compromising telencephalic images, offering a novel perspective for the diagnosis and research of cerebellar disorders using 7.0 T MRI. Please see text page 60.

CASE REPORT

REVIEWS