

Advancements in MRI
Conditionality of Spinal Cord
Stimulation Systems:
A Narrative Review of Recent
SCS Systems and MRI
Operational Risks

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- Background:
- SCS is key for chronic, treatment-resistant pain.
 - MRI can disrupt SCS function — causing heating & malfunctions.
 - New SCS devices are safer, but awareness of MRI safety remains crucial.

- Objectives:
- Review advances & challenges in MRI-safe SCS devices.
 - Highlight key innovations and safety conditions
 - Provide practical insights for clinicians..

- Methods:
- Analyzed manufacturer manuals, guidelines, literature, and safety data.
 - Identified technological advances, adverse events, and clinical implications in MRI use.
 - Synthesized findings to present an integrated view of MRI safety in SCS therapy.

- Results:
- Notable advancements in MRI-compatible SCS devices include improved lead design, shielding, and programming.
 - These innovations have enhanced safety during MRI procedures.
 - Reports still note malfunctions such as high lead impedance, heating, and MRI mode errors.
 - Some issues have prompted FDA recalls and manufacturer advisories or warnings.

- Conclusion:
- MRI-compatible SCS devices are safer than ever.
 - Ongoing innovation & vigilance remain essential.
 - Future work must close remaining safety gaps.

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- References:
- Atkinson L, et al. Recommendations for patient selection in spinal cord stimulation. J Clin Neurosci. 2011;18:1295–1302.
 - Jabehdar Maralani P, et al. MRI safety and devices: An update and expert consensus. J Magn Reson Imaging. 2020;51:657–674.
 - Rubino S, et al. MRI conditionality in patients with spinal cord stimulation devices. Stereotact Funct Neurosurg. 2016;94:254–258.
 - Mullins CF, et al. Elevated lead impedances in MR-conditional SCS devices. Pain Pract. 2024;24:270–277.
 - Jotwani R, et al. Failure of SCS MR-conditional modes due to high impedance. Pain Ther. 2021;10:729–737.
 - FDA Recall Notice. Abbott Medical Recalls Proclaim & Infinity IPGs – MRI Mode Failure. U.S. FDA, 2023.
 - Hagedorn JM, et al. MRI ineligibility following 10 kHz SCS implantation. Neuromodulation. 2022;25:719–723.



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MRI-compatible spinal cord stimulation (SCS) devices have significantly improved safety and diagnostic integration, but residual risks such as device malfunction and heating persist, underscoring the need for ongoing vigilance and continued technological refinement



Table 1: Key MRI-SCS phrases and their definition

Status	Definition
MRI Safe	A medical device that poses no known hazards resulting from exposure to any MR environment. MR Safe medical devices are composed entirely of materials that are electrically nonconductive, non-metallic, and nonmagnetic
MRI Conditional	A medical device with demonstrated safety in the MR environment within defined conditions including conditions for the static magnetic field, the time-varying gradient magnetic fields, and the radiofrequency fields
MRI Unsafe	A medical device which poses unacceptable risks to the patient, medical staff or other persons within the MR environment
Note: The term MR Compatible, which appeared in a 1997 FDA draft guidance document and was frequently misinterpreted, is obsolete, and should not be used. ASTM F2503-20 Standard Practice for Marking Medical Devices and other Items for Safety in the Magnetic Resonance Environment. ASTM International. ASTM = American Society	

Table 2: Comparison of MRI-Compatible Spinal Cord Stimulation Systems Across Major Manufacturers (Summary table from 9 different systems; adapted from the original manuscript)

Manufacturer	Key Models	MRI-Safe	Distinct Features
Boston Scientific	WaveWriter Alpha, Montage MRI	1.5 T	Rechargeable, full-body MRI, 30 min scan limit
Abbott	Eterna, Proclaim XR, DRG	1.5 T	MRI, automatic mode, 0.1 W/kg SAR
Medtronic	Inceptiv, Intellis, Vanta	1.5 T–3 T	SureScan tech, impedance-independent
Nevro	Senza, HFX iQ	1.5 T and 3 T	Full-body MRI, high-frequency 10 kHz therapy
Saluda	Evoke (closed-loop)	1.5 T/3 T	Full-body MRI; FDA cleared 2022
Biotronik	Prospera	1.5 T & 3 T	MRI, rechargeable IPG, new RESONANCE™ waveform
Curonix	Freedom-8A	1.5 T/3 T	with transmit-receive coils, ≤4°C temp rise
Nalu	Mini IPG series	1.5 T/3 T	small external power unit, full-body 1.5 T safe