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A Rapid MRI Protocol for Acute Pediatric Musculoskeletal Infection Eliminates Contrast, Decreases Sedation, Scan and Interpretation Time, Hospital Length of Stay, and Charges

Kyle S. Chan[1]; Daniel McBride[2]; Jacob Wild[2]; Soyang Kwon, PhD[3,4]; Jonathan Samet, MD[5,6]; Romie F. Gibly, MD, PhD[1,2]

[1]Northwestern University Feinberg School of Medicine, Department of Orthopaedic Surgery, Chicago, IL; [2]Ann & Robert H. Lurie Children's Hospital of Chicago, Division of Orthopaedic Surgery and Sports Medicine, Chicago, IL; [3]Stanley Manne Children's Research Institute, Ann & Robert H. Lurie Children's Hospital of Chicago, Chicago, IL; [4]Department of Pediatrics, Feinberg School of Medicine, Northwestern University, Chicago, IL; [5]Ann & Robert H. Lurie Children's Hospital of Chicago, Department of Radiology, Chicago, IL; [6]Northwestern University Feinberg School of Medicine, Department of Radiology, Chicago IL

Correspondence: Romie F. Gibly, MD, PhD, Ann & Robert H. Lurie Children's Hospital of Chicago, 225 E. Chicago Ave., Box 69, Chicago, IL 60611. E-mail: rgibly@luriechildrens.org

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Abstract

Introduction: Acute musculoskeletal infections (MSKi) affect >1:6000 children in the United States annually, which could lead to arthritis, chronic infection, limb deformity, and even death. MRI is the gold standard for MSKi diagnosis but traditionally requires contrast and anesthesia, delaying results and slowing treatment decision-making. A rapid MRI protocol is an unsedated MRI with limited non-contrast sequences optimized for fluid detection and diffusion-weighted images to help identify abscesses. The objective of this study was to compare MRI access, timing, treatment, length of stay, and charges between the traditional and rapid MRI protocols among pediatric patients undergoing MSKi evaluation.

Methods: A single-center retrospective study was conducted among 128 patients undergoing MSKi evaluation before ("Traditional cohort" [TC] of 60 patients admitted in Jan-Dec 2019) and after implementation of the rapid MRI protocol ("rapid cohort" [RC] of 68 patients admitted in Jun 2021-Jul 2022). Demographic, clinical, and charge data were extracted from electronic health records. Mann-Whitney U tests were performed to compare the two groups.

Results: Demographics and diagnoses were similar, while rates of sedation and contrast administration were significantly different (53% and 88% in TC versus 4% and 0% in RC). The median time to MRI after ordering was 6.5 hours (IQR=3.2, 12.2) in TC and 2.2 hours (IQR=1.1, 4.5) in RC ($p<0.01$). The median duration of MRI was 63.2 minutes (IQR=52.4, 85.3) in TC and 24.0

minutes (IQR=18.5, 41.1) in RC ($p<0.01$). The median time between ordering and receiving the MRI final interpretation was 13.5 hours (IQR=2.35-66.3) in TC and 7.0 hours (IQR=1.25- 41.7) in RC ($P<0.01$). The median hospital length of stay was 5.3 days (IQR=2.7, 7.9) in TC and 3.7 days (IQR=1.0, 5.8) in RC ($p<0.01$). The median charges were $47,309 (IQR=$27,696, $81,048) in TC and $32,824 (IQR=$13,563, $53,027) in RC ($p<0.01$). While 10/68 of rapid MRIs resulted in nondiagnostic outcomes due to patient motion, only 6/68 required repeat MRI with sedation. Only two cases of MSKi were missed upon initial rapid MRI, but these instances were not attributable to the rapid protocol itself.

Conclusion: In patients being evaluated for MSKi, the rapid MRI protocol eliminated contrast and nearly eliminated sedation while leading to improved MRI access, scan and interpretation times, and significant decreases in hospital length of stay and charges. Future steps include continuing quality control, studying interobserver reliability between protocols, and multicenter program expansion.

Significance: Pediatric MSKi carry a large treatment burden, and this rapid MRI protocol improves imaging access while eliminating contrast, decreasing sedation, scan time, length of stay, and hospital charges, with a <10% rescan rate.

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