Introduction: Mapping motor cortex with transcranial magnetic stimulation (TMS) can inform brain plasticity and neurophysiology. TMS is safe and well tolerated in children but mapping is technically challenging and prone to human error. Emerging TMS robot technology has not been applied to motor mapping or children. We aimed to determine the feasibility and validity of robotic TMS motor mapping in children.

Methods: Twelve typically developing, right-handed participants aged 9-18 years provided informed consent/assent. All underwent standardized MRI at 3T with T1 anatomical images uploaded to a neuronavigation system (Brainsight 2, Rogue). The participant, MRI, and TMS were co-registered within a TMS robotic system (Axilum). The motor hotspot and rest motor threshold for contralateral first dorsal interossei were mapped with surface EMG. An individualized grid (10X10, 7mm intervals) was centred over the hotspot. Responsive points were defined by having ≥2/4 suprathreshold single pulses produce an MEP amplitude >50µV. Outcomes included motor map graphs, area, volume, and centre of gravity. Bilateral motor function was determined using Perdue Pegboard Task (PPT). Safety and tolerability was evaluated.

Results: Procedures were well tolerated with no adverse events. Two young subjects had high rest motor thresholds that precluded mapping. In the remaining 10, high resolution motor cortex maps were generated (see figure). Once thresholding was complete, motor mapping took 15-20 minutes per subject. Neuronavigation combined with near-real-time motion correction by the robotic arm provided high precision. Typical outcomes included motor map areas of 14.11±2.01 cm² (range=8.33-29.89) and volumes of 0.81± 0.29 cm³ (range=0.28-3.34). No effects of age or gender were suggested. PPT score was possibly correlated with motor map volume (r=0.48, p= 0.16).

Conclusion: Robotic TMS motor mapping is feasible, efficient, accurate and tolerated in children. The ability to quickly generate detailed, individualized maps suggests utility as a neurophysiological biomarker of motor cortex dysfunction and plasticity.
Keywords: Robotic Transcranial Magnetic Stimulation (TMS), Motor Mapping, Pediatrics