Weill Cornell Medicine

Magnet-Actuated Craniofacial (MAC) Distraction System for Improved Treatment of Craniofacial Deformities

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Background & Unmet Need

- Craniosynostosis is a condition characterized by premature fusion of cranial sutures that affects ~ 1 in every 2,500 live births globally
- If left untreated, craniosynostosis can lead to disrupted skull growth, elevated intracranial pressure and serious neurodevelopmental abnormalities
- Craniofacial distraction osteogenesis (DO) enables gradual distraction and controlled bone regeneration for patients with abnormal craniofacial morphology
- However, conventional craniofacial DO systems require external activation ports that increase the risk of wound infection, mechanical failure, and premature removal of the distraction system.
- Additionally, manual external actuation introduces user-dependent variability and mechanical inconsistency
- **Unmet Need:** Craniofacial DO systems with reduced risk of infection and more precise control of the distraction mechanism

Technology Overview

- **The Technology:** A magnet-actuated craniofacial (MAC) distraction system for contactless, noninvasive delivery of the mechanical forces required for craniofacial DO
- The MAC system exploits magnetic coupling between external and internal magnets to generate noninvasive, controlled mechanical forces without direct physical contact with the external environment
- Three-dimensional magnetostatic finite element modeling (FEM) demonstrated the feasibility of achieving clinically relevant transmissible torque using magnetic actuation
- **PoC Data:** In a cadaveric feasibility study, the MAC system exhibited reliable mechanical performance, positional stability, and resistance to back-drivability under anatomically relevant conditions

Inventors:
Mohammed Fouda
Caitlin Hoffman

Patents:
US Applications Filed

Publications:
Fouda et al. *J Neurosurg Pediatr.* 2026.
Fouda et al. *Ann Biomed Eng.* 2026.

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Cornell Reference:
D-10735, D-11332

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Technology Applications

- Treatment of complex craniosynostosis, including syndromic, multi-suture craniosynostosis
- Treatment of other craniofacial abnormalities such as mandibular micrognathia and midface hypoplasia

Technology Advantages

- Potential to reduce the risk of infection and mechanical failure
- Magnetic coupling enables predictable, adaptable, and patient-specific control of distraction kinetics

Supporting Data / Figures

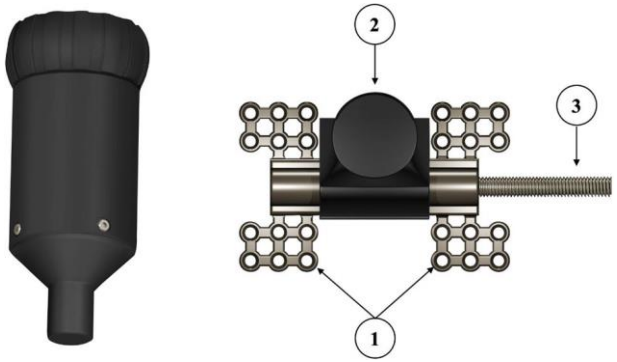

Figure 1: Overview of the MAC distraction system. The system is comprised of (1) bilateral cranial baseplates with multiple circular apertures for screw-based attachment to the skull, (2) a central housing unit containing the internal actuation mechanism, and (3) a threaded driving screw to enable gradual distraction. During operation, the external handheld driver is positioned over the skin above the internal magnet; rotation of the external magnet generates a magnetic field that induces synchronous rotation of the internal magnet..

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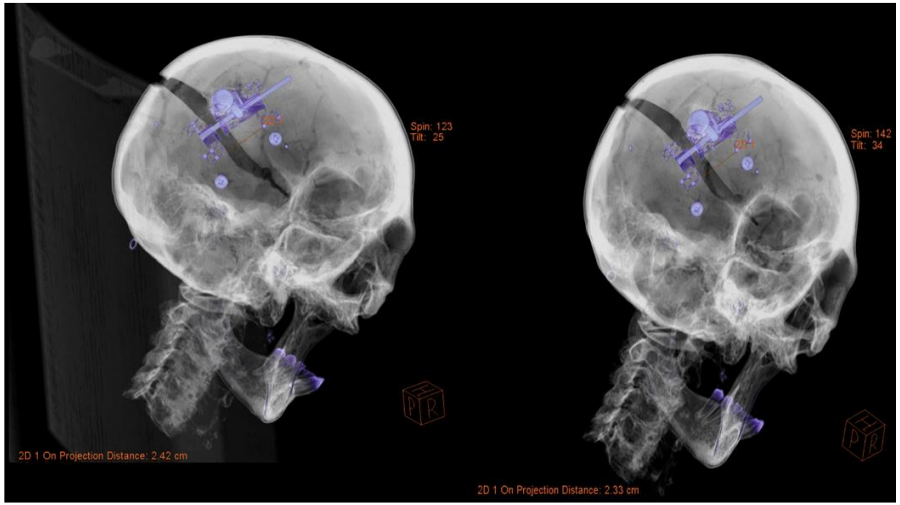

Figure 2: 3D volume rendered CT reconstruction demonstrating the implanted cranial device in situ. The device remained appropriately positioned across the osteotomy site. Quantitative measurements revealed a progressive increase in separation from initiation (right) and completion (left).

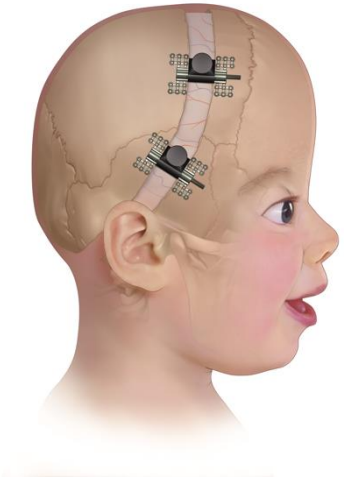

Figure 3. Illustration of the MAC distraction device positioned on a pediatric patient model.

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