Transcranioplasty ultrasound

Previously, sonographic evaluation of the intracranial contents was limited to intraoperative use following bone flap removal, with placement of the probe directly on the cortical surface or through a transsulcal tubular retractor. Cranioplasty with sonolucent implants may represent a postoperative window into the brain by allowing ultrasound to serve as a novel bedside imaging modality.

A study examined the potential to image the brain using transcranioplasty ultrasound (TCU) through a sonolucent cranial implant.

A validated adult brain phantom was imaged using computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound without an implant. Next, for experimental comparison, TCU was performed through a sonolucent implant composed of clear polymethyl methacrylate.

All imaging modalities successfully revealed elements of the brain phantom, including the bilateral ventricular system, the falx cerebri, and a deep hyperdense mass representing a brain tumor or hematoma. In addition, ultrasound images were captured which closely resembled axial images obtained with both CT and MRI.

The results obtained in this first-ever, preclinical, phantom study suggest TCU is now a viable immediate and long-term diagnostic imaging modality deserving of further clinical investigation [1].

The potential sonolucency of various commonly used cranial implant types was examined in a study.

A 3-phase study was comprised of cadaveric evaluation of transcranioplasty ultrasound (TCU) with cranioplasty implants of varying materials, intraoperative TCU during right-sided cranioplasty with clear implant made of poly-methyl-methacrylate (PMMA), and bedside TCU on postoperative day 5 after cranioplasty.

The TCU through clear PMMA, Polyetheretherketone, and opaque PMMA cranial implants revealed implant sonoluceny, in contrast to autologous bone and porous-polyethylene. Intraoperative ultrasound via the clear PMMA implant in a single patient revealed recognizable ventricular anatomy. Furthermore, postoperative bedside ultrasound in the same patient revealed comparable ventricular anatomy and a small epidural fluid collection corresponding to that visualized on an axial computed tomography scan.

Sonolucent cranial implants, such as those made of clear PMMA, hold great promise for enhanced diagnostic and therapeutic applications previously limited by cranial bone. Furthermore, as functional cranial implants are manufactured with implantable devices housed within clear PMMA, the possibility of utilizing ultrasound for real-time surveillance of intracranial pathology becomes much more feasible [2].

1)

Belzberg M, Shalom NB, Lu A, Yuhanna E, Manbachi A, Tekes A, Huang J, Brem H, Gordon C. Transcranioplasty Ultrasound Through a Sonolucent Cranial Implant Made of Polymethyl Methacrylate: Phantom Study Comparing Ultrasound, Computed Tomography, and Magnetic Resonance Imaging. J

Craniofac Surg. 2019 Jun 7. doi: 10.1097/SCS.0000000000005651. [Epub ahead of print] PubMed PMID: 31188246.

2)

Belzberg M, Shalom NB, Yuhanna E, Manbachi A, Tekes A, Huang J, Brem H, Gordon CR. Sonolucent Cranial Implants: Cadaveric Study and Clinical Findings Supporting Diagnostic and Therapeutic Transcranioplasty Ultrasound. J Craniofac Surg. 2019 Mar 27. doi: 10.1097/SCS.0000000000005454. [Epub ahead of print] PubMed PMID: 30939550.