

Revolutionizing neurosurgery: How intraoperative ultrasound enhances precision and patient outcomes

Pre-operative scans are standard in the workflow of most neurosurgical procedures to diagnose and plan the surgery. However, once surgery begins, the brain naturally shifts due to factors like cerebrospinal fluid, meaning those same pre-operative images are no longer as accurate. Adding intraoperative ultrasound (iUS) to the procedure helps surgeons understand that natural change. It also gives them more up-to-date data and imaging for planning the procedure.

Impact of intraoperative ultrasound: Clinical evidence and surgeon insights

In a 2016 study published in the *European Spine Journal*, iUS was shown to change the course of the surgery in 63% of cases.¹

Other studies have shown similar positive results, including intraoperative guidance reducing proximal shunt failure and ultrasound-guided ventricular catheter placements proving significantly more accurate than freehand placements. In pediatric patients, a 31% reduction in shunt revision rates was shown, and a 16% reduction in adult shunt revision rates.² In spinal procedures, visualizing soft tissue in detail with intraoperative ultrasound allows the surgeon to monitor spinal cord health, verify extent of decompression and adapt surgical plans. These are only a few examples of data being collected specifically for iUS technology in the neurosurgical space.

One neurosurgeon at Birmingham Children's Hospital, who routinely uses iUS in his surgical workflow, recently commented that the ultrasound helps him visualize the resection margin, which is exactly where the tumor ends and where the healthy brain tissue begins. By staying along this boundary, it helps the surgeon preserve the patient's neurological functions such as movement, speech and sight. This is where intraoperative ultrasound solutions, like the bkActiv, can provide reassurance where it matters most—during the procedure. The bkActiv is GE HealthCare's real-time iUS imaging platform for neurosurgery and spine surgery.

Advanced features and integration of the bkActiv platform

The bkActiv platform is designed for neurosurgical subspecialties and is tailored to not only the neurosurgeon, but also the operating room (OR). The system itself is a small footprint with an extended-reach monitor that can switch between portrait and landscape options to fit in a crowded OR. The touchscreen interface is customizable and can be adapted for ease of use among OR staff. The bkActiv is equipped with specialized software presets, producing high-quality images tailored to the brain and spine.



The bkActiv is accompanied by a portfolio of fully sterilizable transducers optimized for neurosurgical and spine subspecialties. The craniotomy transducer is used for many craniotomy and spinal procedures. It has a wide field of view and can be used for different imaging depths. The shunt transducer is a procedural, small-footprint transducer that excels at imaging fluid-filled objects such as ventricles and cysts. The hockey stick transducer is a high-resolution transducer designed for peripheral vessel, musculoskeletal, intraoperative, intraoperative neuro and small parts procedures. The minimally invasive transducer features a long shaft designed for hard-to-reach areas. Each transducer in the bkPortfolio is built to accommodate neurosurgical procedures, providing neurosurgeons added flexibility and function.

Additionally, the software offers various compare modes to assist in visualizing progress throughout the procedure in real time and to support image interpretation. Picture-in-picture mode, stored image compare and dual live compare all work to provide neurosurgeons with additional insight and functionality during the procedure.

The bkActiv and Brainlab neuronavigation systems offer a full plug-and-play experience for intraoperative ultrasound navigation. The software allows for instant transmission of data without the need for separate calibration and there's no loss of image quality. Real-time iUS images, in 2D or 3D, can be overlaid onto pre-operative MRI or CT images for accurate orientation and correlation.³ This overlay can provide the surgeon with instant identification and assessment of brain shift and enable surgeons to compensate for it.⁴

As shown by Sweeney et al, repeated iUS scans can ensure continuous monitoring of resection progress and verify extent of resection with minimal interruption of surgical workflow in contrast to other intraoperative imaging modalities (e.g., iMRI, iCT).⁵ A 2021 study published in Neurosurgical Focus showed that 42.5% of cases using intraoperative ultrasound navigation resulted in a favorable change in surgical decision-making.³ The craniotomy, shunt and hockey stick transducers are compatible with digital integration with neuronavigation.

As care pathways continue to improve with advancements in real-time advanced visualization, intraoperative ultrasound in neurosurgery is helping drive progress and empower neurosurgeons. By equipping them with powerful tools like iUS, neurosurgeons can perform more precise surgeries, which will improve patient outcomes and ultimately transform lives across the globe.



References

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