FACT SHEET

NATIONAL INSTITUTES OF HEALTH

Image-Guided Interventions

Yesterday

- For most of the history of medicine, physicians relied on their senses – primarily vision and touch – to diagnose illness, monitor a patient's condition, and perform invasive procedures. During the last few decades various three-dimensional medical imaging techniques, such as computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound, have become available that allow a physician to see and diagnose disease that is hidden from normal view.

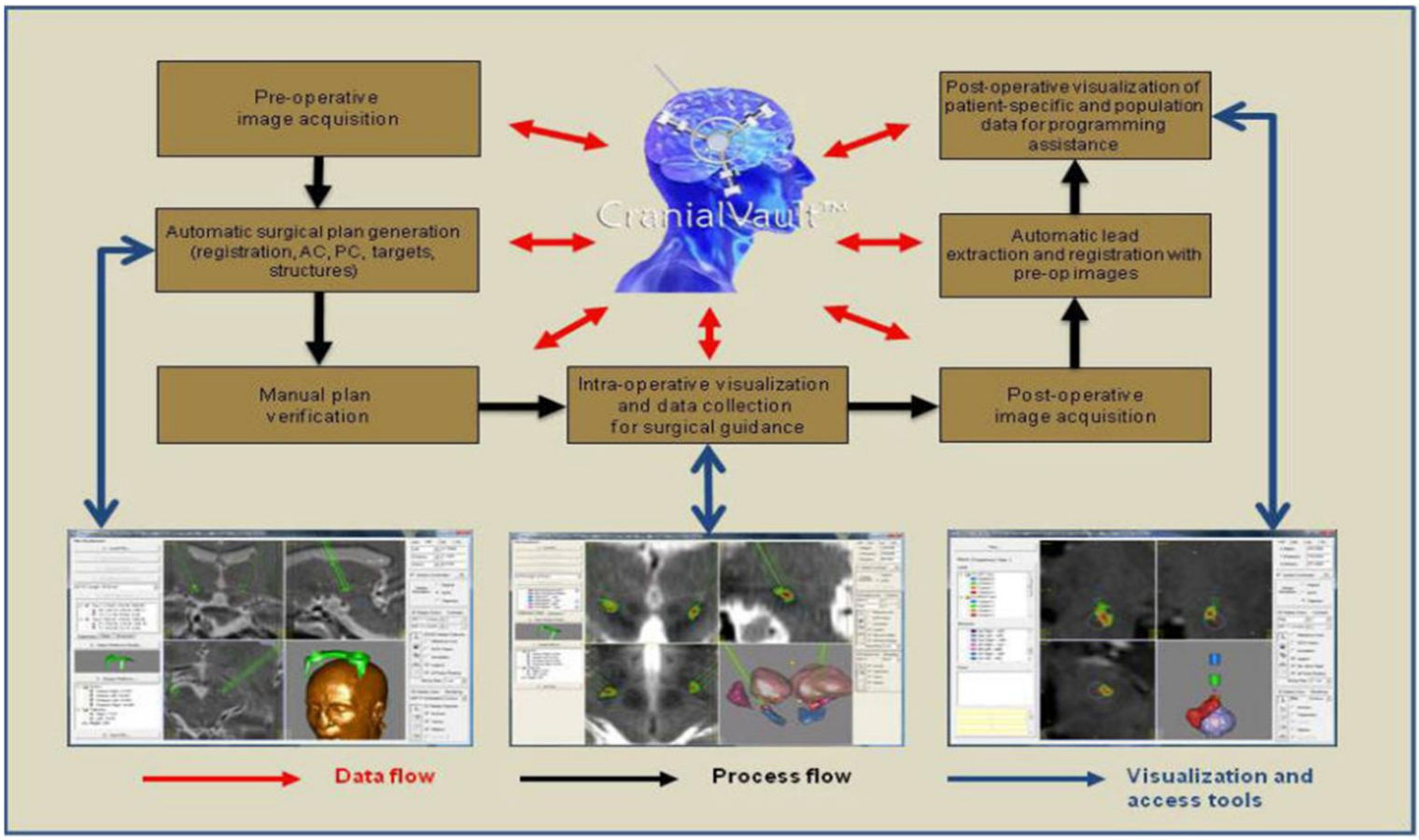
Today

Three-dimensional biomedical images are now being used not only for diagnosis, but for planning and conducting treatment strategies and surgeries, a concept referred to as image-guided interventions.

- A multidisciplinary team of researchers developed a new computerized brain mapping technology that, when combined with image-guidance, greatly improves the success rate of surgery to remove seizure-causing brain regions in patients with debilitating and untreatable epilepsy. This system re-defines the state-of-the-art for epilepsy surgery specifically and neurosurgery in general.
- MRI makes a profound difference in the detection of breast cancer, finding invasive cancers early when they are very small and easier to treat. MRI is also better at finding multiple sites of breast cancer in the same breast.
- Optical-based cellular imaging can detect the cells of other cancers at the earliest stages of disease, enabling life-saving intervention.
- Minimally-invasive, image-guided robotic procedures have replaced open surgeries for prostate cancer.
- In the past, most women who had uterine fibroids with symptoms required surgery to correct the problem. Today, fibroid tumors can be non-invasively mapped and sized using MRI and then treated with high-intensity focused ultrasound.
- MRI-guided cardiovascular interventions allow doctors to view the coronary arteries in 3D, pinpointing the location of an obstruction and its relationship to surrounding vessels.
- Ultrafast CT scanning can non-invasively image the heart and coronary artery disease, and can be used to guide cardiac procedures.
- Image-guidance can be used to place electrodes deep in the brain to reduce or eliminate tremors associated with Parkinson's disease.
- The quest for more accurate and effective minimally-invasive surgical interventions resulted in the introduction of computer-assisted robotic technology, whereby the surgeon works under image guidance with small tools through small incisions. However, current instrumentation prohibits the surgeon from actually feeling the forces exerted when manipulating tissue. To overcome this problem, researchers developed instruments with 3D touch sensors designed to give the surgeon a feeling comparable to that of performing the task manually.

Tomorrow

- Advances in computer technology, coupled with an increase in the accuracy and sensitivity of imaging technologies, will make it possible to seamlessly integrate diagnosis and treatment. Future image-guided interventions will enable medical practitioners to detect critical illnesses at their most curable stage – oftentimes at the cellular level, before any symptoms or signs are noticeable. Finally, reengineering of advanced imaging technologies and the development of new imaging sensors will lower the cost of these technologies, making them accessible to more patients.



The CranialVault database and CRAVE user interface tools provide access to data from hundreds of patients who have undergone deep brain stimulation surgery. The interface tools help neurosurgeons reduce surgery time by pinpointing optimal sites for electrode implantation and more rapidly programming a patient's pulse generator to eliminate symptoms associated with movement disorders. *Courtesy of Vanderbilt neurosurgeon Peter Konrad and computer science researchers Benoit Dawant and Pierre-Francois D'Haese.*

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