

MR-Guided Robotic Surgery

Garnette R. Sutherland, M.D.

To improve upon interoperative lesion localization and resection control, several investigators translated MR-imaging technology into the operating room. The systems were initially of an open configuration and contained relatively low field magnets. Signal to noise and contrast to noise were improved with the evolution of iMRI systems with higher field magnets, which are closed systems. These closed systems interrupted surgery for imaging, and therefore the systems are generally used to evaluate the extent of surgery rather than to guide surgery. In order to fully utilize the rich array of images, surgery must occur inside the magnet while images are being produced. A robotic surgical system provides the ability to perform surgery inside the magnet so that surgery and imaging can occur simultaneously.

Serendipitously, the remote workstation from which the surgeon teleoperates the robotic manipulators centralizes and fuses imaging data, enabling the surgeon immediate access to current patient information as well as digitized knowledge from the global community. Contemporary MR compatible robots take advantage of the many ongoing advances in material science, audio-visual systems, and haptics. Miniaturization of components enables the process towards creation of dexterous manipulators similar to the human hand. Furthermore technology offers the possibility of accessing visual, tactile, and audio information outside the range of human senses. When current advances in molecular imaging technology combine with these advances in robotic surgery, this paradigm has the potential to convert the scope of surgery from the present level of the organ to the cellular dimension.