ROBOTICS IN NEURO-SURGERY

It is an established fact that with the advent of modern technology in the field of medical science, there has been significant and conspicuous increase in the adoption of less invasive medical procedures for curing human ailments with greater accuracy. The application of Robotics in medical science is one of the pioneering modern technologies that has substantially revolutionized the health care system. Robotic surgery systems offer precise, accurate and easily replicated results that can greatly assist Surgeons and improve patient outcomes consequent of which these systems are proliferating rapidly during current times. The application of Robotics in Neurosurgery has been watershed moment in neurosurgical procedures enabling Neuro-Surgeons to perform surgical procedures accurately and tirelessly and therefore there has been increased interest in robotic applications in neurosurgery as the demand for minimally invasive approaches to the brain and spine has grown, however, incorporation of such system is associated with some limitations due to hardware maintenance, cost and sterilization. Nevertheless, as new technologies continue to emerge, it is now possible to predict how neurosurgical robotics will progress in the coming years.

The most commonly used Robotic systems in neurosurgery are **NeuroMate, PathFinder, NeuroArm, SpineAssist** and **Renaissance**. The **NeuroMate** robot system is an image-guided robotic assisted system for brain surgery which is a commercially available system used today for stereotactic procedures in neurosurgery. **PathFinder** is a surgical robot which has been designed to maximise the benefits of the mechanical arm.The PathFinder system consists of planning work station and a positioning robot which involves 2 stages i.e. pre-operative planning and surgical implementation. Using PathFinder, the surgeon can specify a target and a trajectory on a medical image and the information is then converted into robot movements which can cause an instrument guided by the robot to be positioned in precisely desired location. The registration and tool calibration are carried out semi-automatically and obstruction of the surgical site is minimized. **NeuroArm** is an engineering research surgical robot specifically designed for neurosurgery and is first image guided, MR-compatible surgical robot that has a capability to perform both micro-surgery and stereotaxy. NeuroArm includes two remote detachable manipulators on a mobile base, a workstation and a system control cabinet. For Biopsy stereotaxy, either the left or right arm is transferred to a stereotactic platform that attaches the MR bore. The procedure is performed with image guidance as MR images are acquired in near real-time. The end-effectors interface with surgical tools which are based on standard neurosurgical instruments. **SpineAssist** device is the only surgical robot designed to operate on the spine, although it is expected to also be approved for brain surgery. The SpineAssist device was designed with a goal of increasing precision during surgery while reducing radiation exposure and time of the surgery. The device is being used for surgeries where implants are attached to the spine e.g. spinal fusion, correcting scoliosis etc The final goal of the SpineAssist device is to allow surgeons to practice and plan their surgery within a 3D model. **Renaissance** robot surgical system is a minimally invasive robotic guided spine surgery technique that requires only a little amount of incision. It transforms spine surgery from free hand procedures to highly accurate, state-of-the-art robot procedures, with less radiation and is used for procedures including minimally invasive surgery, scoliosis and other complex deformities.

An analysis of recent and ongoing clinical trials pertaining to Neurological Robotic Surgery has been conducted to gauge the current prevalence of Robotics in Neurosurgical programs within the United States and assess future applications of Robotics in Neurosurgery through a review of on-going clinical trials. The US News and World Report's "Best Hospitals for Neurology and Neurosurgery" list was accessed in January 2022 to compile a list of the top 100 ranked neurosurgical hospitals in the United States wherein the analysis of future applications for Robotics in Neurosurgery through the clinical trial database showed a paucity of ongoing studies in this arena. As has been observed from the results of the study, Neurosurgery has not seen wide adoption in the usage of robotics despite the rich history of neurosurgical innovation in stereotaxy and brain localization, the highly technical nature of the field and the continued demand for minimally invasive procedures. Neurosurgical robotics also requires a certain degree of mathematical literacy, posing barriers to an already congested healthcare system.

CONCLUSION

Robotic neurosurgery is still in its infancy with less than half of the top programs offering robotic procedures. Future directions for robotics in neurosurgery appear to be focused on increased automation of stereotactic procedures such as DBS and LITT and robot-assisted spinal surgery. Barriers and challenges still exist within the broad adoption of robotic assistance; however, if we ask the right questions, neurosurgery will continue to innovate as we enter the fourth industrial revolution

SOURCE: INTERNET

REFERENCE

1. R. Singh: Robotics in Neurosurgery- Current prevalence and future directions-PMC

2. Ahmed SI, Javed G, Mubeen B, Bareeqa SB, Rasheed H, Rehman A, et al. Robotics in neurosurgery: A literature review. *J Pak Med Assoc.* 2018;68:258–63. [PubMed] [Google Scholar]

3. D'Souza M, Gendreau J, Feng A, Kim LH, Ho AL, Veeravagu A. Robotic-assisted spine surgery: History, efficacy, cost, and future trends. *Robot Surg.* 2019;6:9–23. [PMC free article] [PubMed] [Google Scholar]

4. Denning NL, Kallis MP, Prince JM. Pediatric robotic surgery. *Surg Clin North Am.* 2020;100:431–43. [PubMed] [Google Scholar]

5. Doulgeris JJ, Gonzalez-Blohm SA, Filis AK, Shea TM, Aghayev K, Vrionis FD. Robotics in neurosurgery: Evolution, current challenges, and compromises. *Cancer Control.* 2015;22:352–9. [PubMed] [Google Scholar]

Others.