Journal of Spine & Neurosurgery

Editorial

A SCITECHNOL JOURNAL

Robot-assisted procedures in pediatric neurosurgery

Lumy Sawaki*

Six During the last 3 decades, robotic technology has rapidly spread across several surgical fields due to the continuous evolution of its versatility, stability, dexterity, and haptic properties. Neurosurgery pioneered the development of robotics, with the aim of improving the quality of several procedures requiring a high degree of accuracy and safety. Moreover, robot-guided approaches are of special interest in pediatric patients, who often have altered anatomy and challenging relationships between the diseased and eloquent structures. Nevertheless, the use of robots has been rarely reported in children. In this work, the authors describe their experience using the ROSA device (Robotized Stereotactic Assistant) in the neurosurgical management of a pediatric population.

Between 2011 and 2016, 116 children underwent ROSA-assisted procedures for a variety of diseases (epilepsy, brain tumors, intra- or extraventricular and tumor cysts, obstructive hydrocephalus, and movement and behavioral disorders). Each patient received accurate preoperative planning of optimal trajectories, intraoperative frameless registration, surgical treatment using specific instruments held by the robotic arm, and postoperative CT or MR imaging.

The authors performed 128 consecutive surgeries, including implantation of 386 electrodes for stereo-electroencephalography (36 procedures), neuroendoscopy (42 procedures), stereotactic biopsy (26 procedures), pallidotomy (12 procedures), shunt placement (6 procedures), deep brain stimulation procedures (3 procedures), and stereotactic cyst aspiration (3 procedures). For each procedure, the authors analyzed and discussed accuracy, timing, and complications.

To the best their knowledge, the authors present the largest reported series of pediatric neurosurgical cases assisted by robotic support. The ROSA system provided improved safety and feasibility of minimally invasive approaches, thus optimizing the surgical result, while minimizing postoperative morbidity.

Robotic assistance was developed in neurosurgical procedures with the aim of improving feasibility and effectiveness of several procedures that require a high level of accuracy and safety, such as biopsy, neuro-endoscopy, radiosurgery, neuro-modulation treatments, and other stereotactic procedures. Recently, more sophisticated systems have been proposed for other complex treatments, such as brain tumor removal, deep electrode placement for stereo-electroencephalography (SEEG) recording, laser ablation in medically intractable epilepsy, and other functional approaches.

***Corresponding author:** Dr. Lumy Sawaki, PhD, Department of Neurology, University of Kentucky College of Medicine, USA, Tel: +1 894 2575398; Fax: +1 894 2575398; E-mail: Sawaki.lumy@gmail.com

Received: February 12, 2021 **Accepted:** February 24, 2021 **Published:** February 28 2021

In this context, robotic technology is continuously improving, mainly in terms of versatility, adaptability, geometric accuracy, stability, and repeatability, integration of extensive information, safety, dexterity, tactile feedback, and hand-eye coordination. The main goal of this technology is to enhance the surgeon's skills so that he or she can perform microsurgical manipulations, minimally invasive access procedures, accurate stereotactic approaches, and image-guided procedures. In particular, 3 possible surgeon-robot interaction modalities have been described, depending on whether the robot performs specific preplanned motions under the supervision of the surgeon (supervisory-controlled system), if the surgeon directly controls the robotic manipulator through a haptic interface (telesurgical system), or if the robot and surgeon jointly control the surgical instrument (shared-control system).

Moreover, robot-guided methods are of special interest in pediatric neurosurgery. In fact, many brain diseases that occur during childhood, such as hydrocephalus, epilepsy, tumors, and movement and behavioral disorders, often constitute a particular challenge for neurosurgeons. Developing structures are more vulnerable to injury than the developed structures in adults, especially with regard to small and deep targets. In addition, the normal anatomy of a child's brain is often altered by specific constitutional factors (e.g., malformations) or by the disease itself. Consequently, neurosurgical management of these cases requires careful preoperative planning and a high degree of intraoperative precision to correctly identify and reach the surgical target without damaging the surrounding eloquent neurovascular structures.

Nevertheless, robot-assisted approaches have been reported infrequently in pediatric patients. Moreover, the cases described in the literature mainly concern urological, abdominal, and cardiac experiences, with rare anecdotal reports on neurosurgical applications.

Among the robotic systems currently used, the Robotized Stereotactic Assistant (ROSA, Medtech) is a recently developed image-guided device that provides guidance for spatial positioning and orientation of several neurosurgical instruments according to a planned trajectory.

Author Affiliation Top

Division of Neurosurgery A, Department of neurology and Psychiatry, Sapienza University of Rome, Italy