Robotic Applications in Neurosurgery

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Introduction

Recent advances in neuro-imaging and stereotactic and computer technology gave birth to minimally invasive keyhole surgery to the extent that the scale of neurosurgical procedures, demanded by patients, will soon be so small that it will not be within the capability of the most gi ed and skilled neurosurgeons of today. Neurosurgical robotics is the natural progression in this eld. Furthermore, the economic advantages, increased precision and improved quality in industrial applications of robotics have stimulated robotic applications in neurosurgery [1]. ese neurosurgical robots have signi cant manipulative advantages over neurosurgeons; neuro-robots are reliable to perform the same procedure over and over, again and again without tiresomeness, variation or boredom. ey possess near absolute geometric accuracy and are impervious to biohazards and hostile environments and can work through very narrow and long surgical corridors most suited for surgery on the brain, which is an organ uniquely suited for robotic applications; it is symmetrically con ned within a rigid container, the skull, and the brain can be easily damaged by even the smallest excursions of surgical instruments. Robots can also see around corners that are beyond the line of sight of the neurosurgeons during operations and in a way, robots extend the visual and manual dexterity of neurosurgeons beyond their limits. Several ergometric studies during surgery were reported that have demonstrated substantial muscle fatigue occurring during procedures related to procedure duration and the angle of surgical instruments [2]. Over the last two decades several systems were developed for use in neurosurgery; some of these neuro-robots have been used in clinical practice while others have not been near a patient because of safety and ethical concerns. Among those robots which were used included the PUMA 200, the Minerva robot from the University of Lausanne in Swtizerland the NeuroMate from Integrated Surgical Systems, the MRI compatible robot developed in Japan, the Evolution 1 (Universal Robotics Systems, Schwerin, Germany), the CyberKnife (Accuracy Inc, Sunnyvale, CA), the RoboSim neurosurgery simulator the neuroArm ,the PathFinder and lastly the SpineAssist .Robots were also integrated within current neurosurgical tools such as the microscope, the SurgiScope stereotactic system (Elkta AB, Stockholm, Sweeden) and the Open Access Database www.i-techonline.com MKM microscope system.

Neurosurgical robotics had a long gestation period spanning over two decades. e main reason for this long period of development is the stringent regulation of health and safety [3]. Dmt

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