



Title	The Neuromate® Neurosurgical Stereotactic Robot
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Aim

CEDIT was consulted for an evaluation of the NeuroMate® neurosurgical robot. The NeuroMate® system from the company ISS is a computer-controlled, image-guided neurosurgery multijointed arm with five degrees of freedom. It allows the stereotactic positioning of an instrument holder usually guiding surgical instruments typically used in stereotactic neurosurgery. It enables, in two possible function modes (with or without stereotactic frames):

- Accurate and automatic positioning of the instrument holder
- Visualization of instrument position in real time on a workstation. The NeuroMate® then acts as a single-axis neuronavigation system, that axis being the depth of penetration in the brain.

Results

The literature in the field is mainly descriptive (feasibility studies). The neurosurgical team in Grenoble, the first to have developed the Neuromate®, is the only one to have provided information on the benefit of robotics in stereotactic neurosurgery, such as reaching targets that are difficult to access, preoperative simulation for teaching purposes, etc. Since the goal is to reach lesions or cerebral functions without touching functional or vascular structures, this robot is used mainly in stereotactic biopsies, functional neurosurgery, and neuroendoscopic surgery. The accuracy of positioning and repositioning the NeuroMate® is shown to be crucial in small-size lesions occurring in deep and highly functional areas. This accuracy, equal to or less than 0.5 mm, is not provided by current techniques of neuronavigation. In addition, use of the robot is part of the current development of functional neurosurgery; whether in pain surgery, deep cerebral stimulation as in Parkinson's Disease, or presurgical exploration of pharmaco-resistant epilepsy. The catalog price of the NeuroMate system is 281 K€(VAT included) for the stereotactic frame-based version (including the robot arm NeuroMate® and its base, a central control unit for the arm, the workstation for visualization, software for planning and position simulation, and accessories). The catalog price of a stereotactic frame and its accessories is 69 K€(VAT included). An additional amount of 183 K€(VAT included) is required for the frameless stereotactic version (head frame and its base, specific localizers, and ultrasound system). The maintenance contract (preventive and corrective) is offered at 48 K€(VAT included) per year. The additional cost of consumables is 174 €(VAT included) per intervention.

Recommendations

This robot is seen to meet the requirements of accuracy, innocuity, and "minimal invasion" characterizing neurosurgical practice. No other technique of neuronavigation currently provides this degree of accuracy. CEDIT recommends the NeuroMate® stereotactic robot for centers handling a large number of patients with stereotactic neurosurgery indications, but also recommends a harnessing of expertise (neurology, neuroradiology, neurosurgery, neurophysiology) with recognized experience in the field. The neurosurgery department of the Henri-Mondor hospital corresponds to these requirements.

Methods

A systematic review of the literature was carried out. Six databases were scanned: MEDLINE, EMBASE, HEALTHSTAR, Pascal, Cochrane, and Current Contents. Also five neurosurgeons were committed as experts. They were interviewed on the innovative aspect and on the medical benefit of the aforementioned device. Three of these experts use the robot, and one of them designed it.

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