EDEN 2020: a new brain surgery robot inspired by nature

Italian universities Politecnico di Milano, Università degli Studi di Milano and Università Vita-Salute San Raffaele join the European team

Milan, 13th June 2016 – A team of researchers from international institutes including Politecnico di Milano, Università degli Studi di Milano and Università Vita-Salute San Raffaele, led by Professor Ferdinando Rodriguez y Baena, expert in robotic medical technology from Imperial College London, has received an €8.3m grant from the European Commission under the **Horizon 2020 program** to develop and test a next-generation **flexible and steerable robotic needle**, which will be able to reach and treat areas deep in the brain without risk to the patient.

In the treatment of brain gliomas (a particularly aggressive type of tumour), controlled and localised drug delivery - a synergised approach to surgery - is currently performed using a straight, rigid cannula which makes it difficult to avoid any obstacles encountered on the path to the tumour.

EDEN2020, a planned four-year project, is the fruit of Professor Rodriguez y Baena's idea to follow nature's lead in establishing the trajectory to be followed through the human tissue. Indeed, the form of the needle-cannula is inspired by that of the bendable, needle-shaped organ that some insects, such as the wood-boring wasp, use to lay their eggs.
Over the last ten years of research, the team of British scientists has succeeded in creating the first prototypes for flexible, miniaturised needles and, now, the extended group of researchers (collaborators in the Europe-wide project also include the University of Groningen and the Technical University of Munich, together with two companies: Renishaw Plc and Xograph Healthcare Ltd) is ready to carry out the first pre-clinical tests on animals in preparation for clinical deployment.

Thanks to modern magnetic resonance techniques, such as diffusion-weighted MRI and tractography, which make it possible to study nervous tissue structure and the organisation of the connections between different areas of the brain, the team of neuroradiologists from the Università Vita-Salute San Raffaele in Italy will provide high-resolution images allowing the surgeon to visualise the tissue affected by the tumour in detail. The resulting images will be used to plan the path of the robotic needle, which the neurosurgeon will then guide using a special joystick. An exteroceptive

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system, located on the outside of the cannula, will track its position through intraoperative ultrasound imaging, while a sensory system on the cannula will measure the needle's curvature, ensuring adherence to the planned path and absolute safety for the patient.
The surgeon will therefore be able to visually monitor the progress of the robotic needle until it reaches the desired treatment site, where the medication will be released through the cannula.

"This is a fascinating project, in which our role as bioengineers is crucial in deploying the technological product in a clinical setting in hospitals", says **Elena De Momi, researcher from the Department of Electronics, Information and Bioengineering at the Politecnico di Milano.**

"In addition to the clinical implications for the treatment of brain tumours and, potentially, other diseases of the central nervous system, this research will enable us to discover more about important aspects of the brain's structure, using the most advanced diagnostic techniques at our disposal in the field of neuroimaging", explains Professor **Andrea Falini, Head of Neuroradiology at the Università Vita-Salute San Raffaele di Milano.**

The researchers also foresee other futuristic yet not-too-technologically-distant uses for their biomimetic surgical robot.
Lorenzo Bello, Full Professor of Neurosurgery at the Università degli Studi di Milano points out: "Eden is an extraordinary platform for integration of the various pre- and intraoperative imaging technologies, and also a useful tool for innovative in situ diagnostics or for performing other kinds of localised treatment (such as deep brain stimulation for Parkinson's disease and laser therapy), revolutionising neurosurgery as we know it".