# Motor cortical reorganization following the restoring of sensory feedback in an amputee patient by the use of novel implanted multichannel intrafascicular electrodes: a TMS mapping study.

UNIVERSITÀ CATTOLICA del Sacro Cuore

IRCCS San Raffaele Pisana

*R. Di Iorio[1], G. Granata[1], F. Vecchio[2], F. Miraglia[2], P. M. Rossini[1,2]*

Brain Connectivity Laboratory
San Raffaele Research Institute
Rome, Italy

1) Inst. of Neurology, Dept. Geriatrics, Neuroscience & Orthopedics, Catholic University, Policlinic A. Gemelli Rome, Italy
2) Brain Connectivity Laboratory, IRCCS San Raffaele Pisana, Rome, Italy

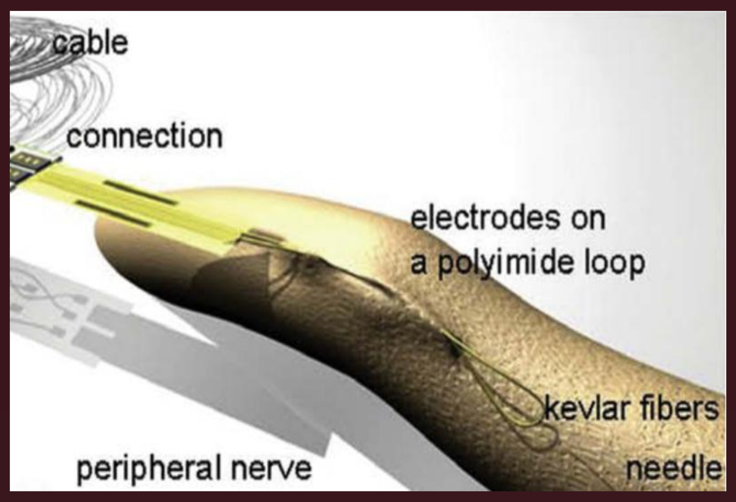
r.diiorio@live.it

## Objective

Aim of this study is to evaluate the motor cortical reorganization with the TMS mapping technique in a left trans-radial amputee patient following the reacquired stream of data resulting from the use of novel implanted multichannel intrafascicular electrodes for multi-movement prosthesis control and for sensory feed-back

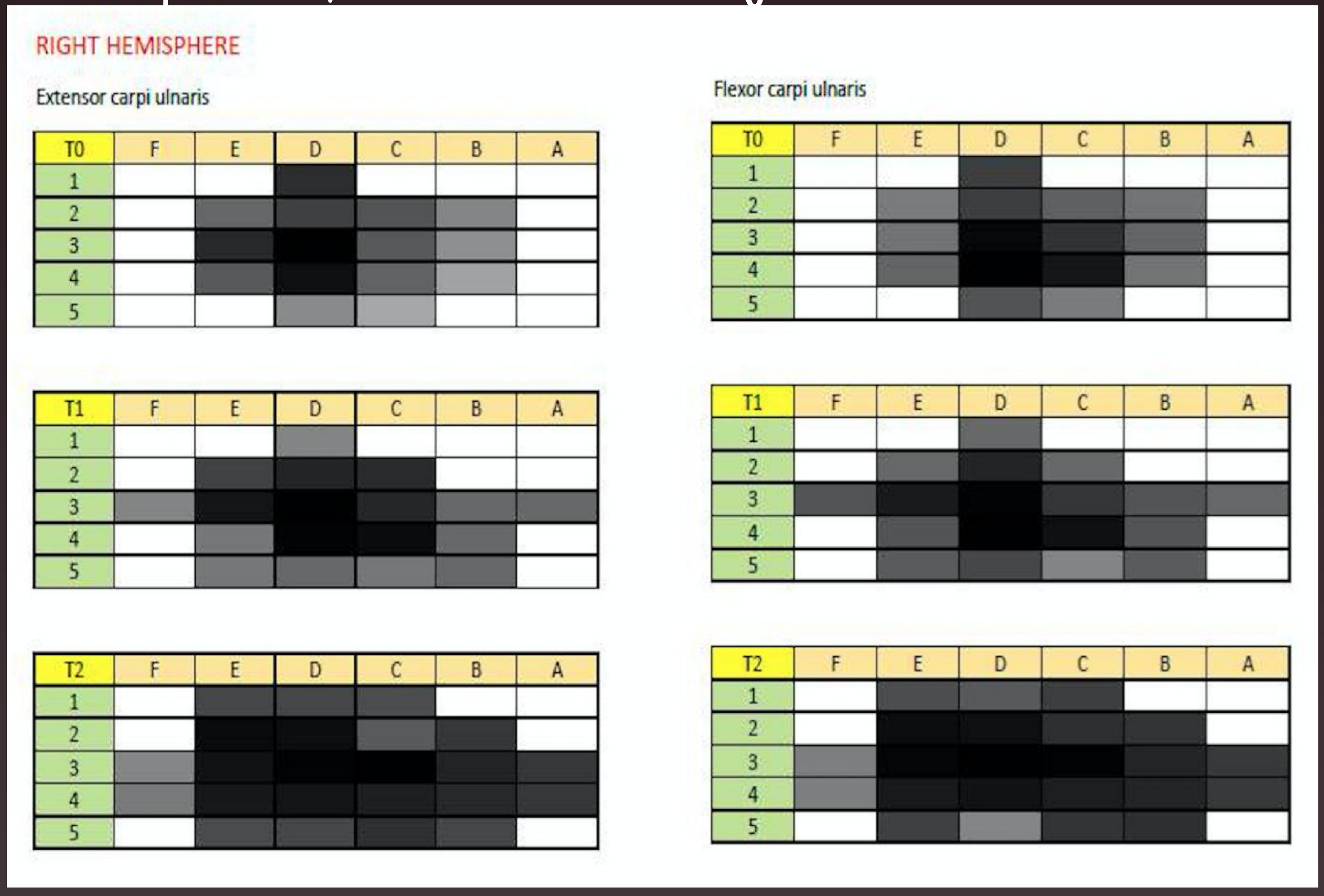

## Materials and Methods

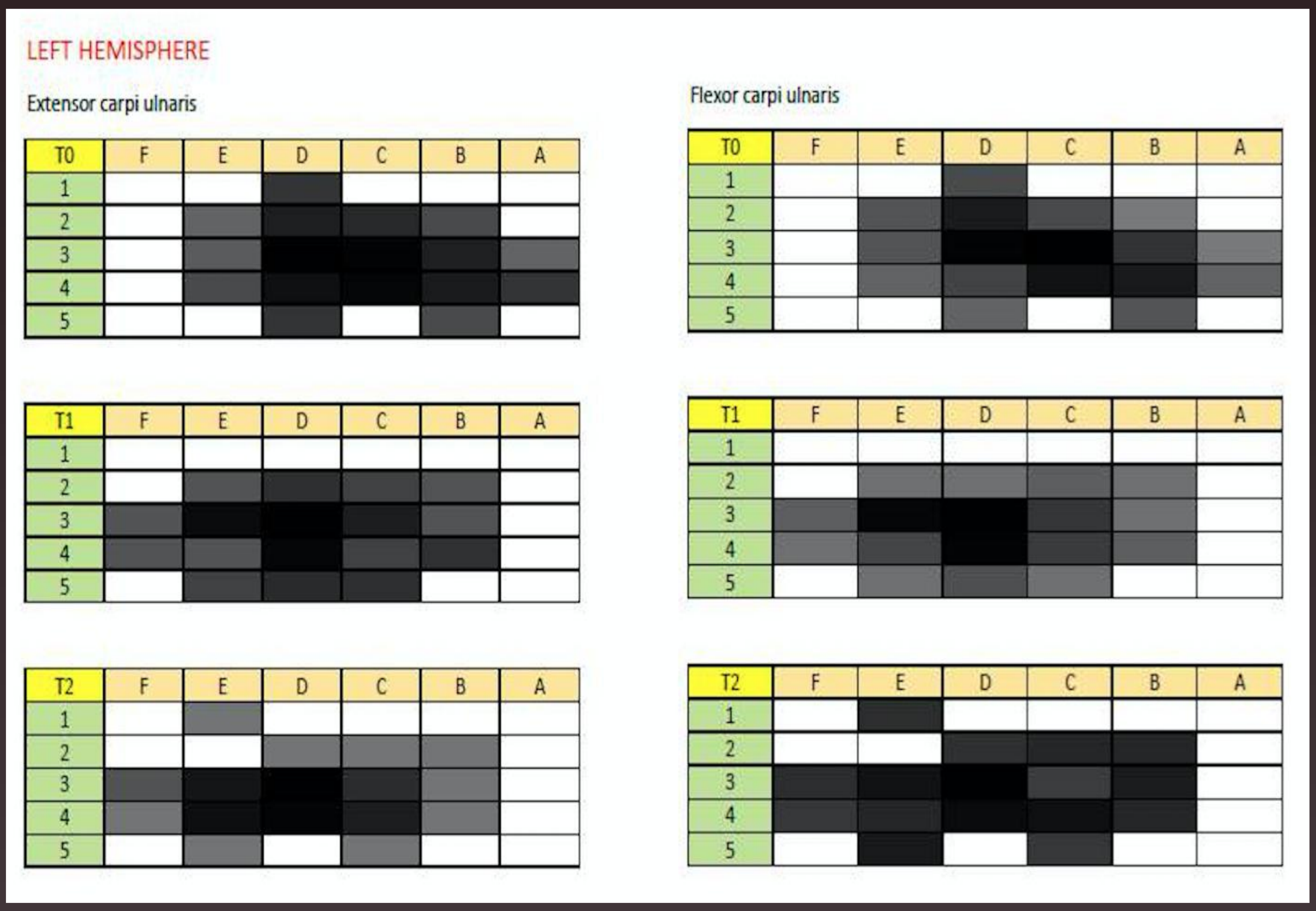
Cortical motor output was mapped via TMS (Magstim200; eight-shaped coil with an inner wing diameter of 70 mm; stimulus rate 0.1–0.2 c/s; intensity 10% above standardised excitability motor threshold) for each hemisphere before implantation, at the end of a training period with intraneural stimulation (1 month after surgery) and at the end of a training period with the robotic hand (2 months after surgery) Peripheral responses were recorded from forearm flexor and extensor carpi ulnaris muscles of both limbs during separate mapping of right and left hemispheres. Resting and Active motor threshold were also collected during separate mapping of right and left hemispheres. The subject wore an elastic cap with a 60-square grid over the sensorimotor cortex. A figure-of-eight coil was used with the virtual cathode centered on the site of the scalp to be stimulated and the holder oriented at 45° angle with respect to the approximate direction of the central sulcus, thereby making current in the brain flow in a posterior-anterior direction.




## Results

No significant differences were found in the motor thresholds between the two hemispheres before and after implantation. Pre-surgical TMS motor maps showed a slight abnormal interhemispheric asymmetry of motor cortex topography, resulted in a smaller area of representation of muscles governing the stump compared to the area for the intact limb. Following training, post-surgical maps, showed a reduction and a partial reversal of this asymmetry because of an enlargement of the excitable area on the right hemisphere contralateral to the stump, leading towards a more symmetrical muscle representation in the two hemispheres, as in control subjects.




## Discussion

The cortical representation of a given muscle can be significantly modified by plastic reorganization following a limb amputation. These plastic changes are not immutable and can be further modified restoring physiological conditions to some extent by the development of new bionic anthropomorphic prostheses connected to the peripheral nervous system via bidirectional neural interfaces.

## Conclusions

Our experiment provides a direct and unique evidence of brain plasticity changes occurring in the motor cortex following the use of a robotic hand to replace the missing limb after amputation.

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