Isolating the circuits that control voluntary movement

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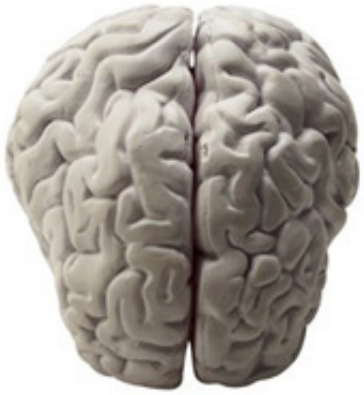

(Medical Xpress)—Extraordinarily complex networks of circuits that transmit signals from the brain to the spinal cord control voluntary movements. Researchers have been challenged to identify the controlling circuits, but they lacked the tools needed to dissect, at the neural level, the way the brain produces voluntary movements.

Recently, Dr. John Martin, medical professor in City College's Sophie Davis School of Biomedical Education, postdoctoral fellow Dr. Najet Serradi and other colleagues employed a sensitive genetic technique that eliminated a particular gene in the cerebral cortex and, in the process, changed the circuitry.

The team hypothesized that the corticospinal tract, which stretches from cerebral cortex to the spinal cord, is important for voluntary reaching movements, but not for more routine and stereotypic walking movements. "We reasoned that if we genetically altered the corticospinal tract we would affect voluntary reaching movements, but not walking." Professor Martin said.

In genetically intact mice, corticospinal tract signals are transmitted from one side of the cerebral cortex to the opposite side of the spinal cord. Such mice reach with one arm, or the other – but not both arms together.

Professor Martin and colleagues used specially bred mice, i.e. knockout mice, with the gene EphA4 removed from the cerebral cortex. These mice reached with both forelimbs together, rather than with one. This happened because the genetic manipulation changed the circuit; it caused the signal to move to be transmitted from one side of the cerebral cortex to both sides of the spinal cord.

However, their stereotypic walking was unaffected. Professor Martin said this shows that while voluntary movements depend on the corticospinal tract walking depends on circuits in other parts of the brain and spinal cord, which are not affected by the gene manipulation.

The findings, he added, "etch away at the vexing problem of achieving a deeper understanding of how the brain functions in voluntary movement." In addition greater knowledge of how voluntary circuits function could lead to new understanding of cerebral palsy, a condition in which the corticospinal tract is injured around the time of birth and people often make "mirror movements" of both arms when they intend to move only one, he said.

The research, which is funded by the National Institute of Neurological Diseases and Stroke, aims to understand the brain and spinal cord circuits for voluntary movement. Using similar genetic tools, his team hopes to further dissect the connections and functions of the corticospinal tract movement circuits in ways to restore movements after brain or spinal cord injury.

The findings were published April 9 in the *Journal of Neuroscience*.

More information: Paper:

www.jneurosci.org/content/34/15/i.short

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