Medical Xpress

How skin is wired for touch

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Compared to our other senses, scientists don't know much about how our skin is wired for the sensation of touch. Now, research reported in the December 23rd issue of the journal *Cell* provides the first picture of how specialized neurons feel light touches, like a brush of movement or a vibration, are organized in hairy skin.

Looking at these neurons in the hairy skin of mice, the researchers observed remarkably orderly patterns, suggesting that each type of hair follicle works like a distinct sensory organ, each tuned to register different types of touches. Each hair follicle sends out one wire-like projection that joins with others in the spinal cord, where the information they carry can be integrated into impulses sent to the brain. This network of neurons in our own skin allows us to perceive important differences in our surroundings: a raindrop versus a mosquito, a soft fingertip versus a hard stick.

"We can now begin to appreciate how these hair follicles and associated neurons are organized relative to one another and that organization enables us to think about how mechanosensory information is integrated and processed for the perception of touch," says David Ginty of The Johns Hopkins University School of Medicine.

Mice have several types of hair follicles with three in particular that make up their coats. Ginty's team made a technical breakthrough by coming up with a way to label distinct populations of known low-threshold mechanoreceptors (LTMRs). Before this study, there was no way to visualize LTMRs in their natural state. The neurons are tricky to study in part because they extend from the spinal cord all the way out to the skin. The feeling in the tips of our toes depends on cells that are more than one meter long.

The images show something unexpected and fascinating, Ginty says. Each hair follicle type includes a distinct combination of mechanosensory endings. Those sensory follicles are also organized in a repeating and stereotypical pattern in mouse skin.

The neurons found in adjacent hair follicles stretch to a part of the spinal cord that receives sensory inputs, forming narrow columns. Ginty says there are probably thousands of those columns in the spinal cord, each gathering inputs from a particular region of the skin and its patch of 100 or so hairs.

Of course, we don't have hair like a mouse, and it's not yet clear whether some of these mechanosensory neurons depend on the hairs themselves to pick up on sensations and whether others are primarily important as scaffolds for the underlying neural structures. They don't know either how these inputs are integrated in the spinal cord and brain to give rise to perceptions, but now they have the genetic access they need to tinker with each LTMR subtype one by one, turning them on or off at will and seeing what happens to the brain and to behavior. Intriguingly, one of the LTMR types under study is implicated as "pleasure neurons" in people, Ginty notes.

At this point, he says they have no clue how these neurons manage to set themselves up in this way during development. The neurons that form this sensory network are born at different times, controlled by different growth factors, and "yet they assemble in these remarkable patterns." And for Ginty that leads to a simple if daunting question to answer: "How does one end of the sensory neuron know what the other end is doing?"

More information: Online paper: DOI:10.1016/j.cell.2011.11.027

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