Cell architecture: Finding common ground

October 16 2014

When it comes to cellular architecture, function follows form. Plant cells contain a dynamic cytoskeleton which is responsible for directing cell growth, development, movement, and division. So over time, changes in the cytoskeleton form the shape and behavior of cells and, ultimately, the structure and function of the organism as a whole. New work led by Carnegie's David Ehrhardt hones in on how one particular organizational protein influences cytoskeletal and cellular structure in plants, findings that may also have implications for cytoskeletal organization in animals. It is published in *Current Biology*.

A cell's cytoskeleton features microtubules, which consist of the protein tubulin assembled into long tubular polymers. Tubulin and tubulin-like proteins are highly conserved evolutionarily, found in some bacteria, fungi, higher plants, and animals. They play critical roles in how cells of these organisms grow and divide.

The work from Ehrhardt's team—which includes Carnegie's Ankit Walia (the lead author), Masayoshi Nakamura, and Dorianne Moss—focuses on microtubule involvement in the growth of plant cells after cell division and discovers a new role for a protein previously known to be crucial for cell division in mammals.

The role of microtubules in animal cell division is well understood. As all school-children learn, cells divide using a process called mitosis, which consists of a number of phases during which duplicate copies of the cell's DNA-containing chromosomes are separated into two distinct cells. A scaffold made of microtubules is crucial for pulling the duplicated halves of the chromosome apart and directing them to each of the new daughter cells.

There is a major difference between microtubule-assisted cell division in plants and animals, however. In animal cells (as well as yeast cells), the microtubules that act to separate chromosomes during cell division are usually organized around a central structure. The arrays of microtubules facilitating plant cell division lack these kinds of central hubs. (Although sometimes in animal cells there are also microtubule arrays that don't form around a center, either.)

How microtubules are properly positioned to perform their function without the aid of a central organizing structure is poorly understood and is the focus of Ehrhardt's present research.

"The quantitative live-cell studies that we have helped to pioneer in plant cells has allowed us to visualize molecular mechanisms underlying the organization of microtubules that lack a central hub structure," Ehrhardt said.

What they found is that a protein called GCP-WD, which plays a key role in the central microtubule organizational structure in mammals, is also crucial in plants. It is key for positioning the formation of individual microtubules in plant cells and also important for the organization and function of plant cell skeletons overall, beyond just the division process.

Thus, GCP-WD is a key factor in determining the form and the function of plant cells, by influencing their architecture.

"In addition to the new insights into plant cell microtubule organization, these observations of GCP-WD function will be of interest to scientists studying microtubules in animals, where GCP-WD has been challenging to observe it in action," Ehrhardt added.