Cohesin opens up for cell division

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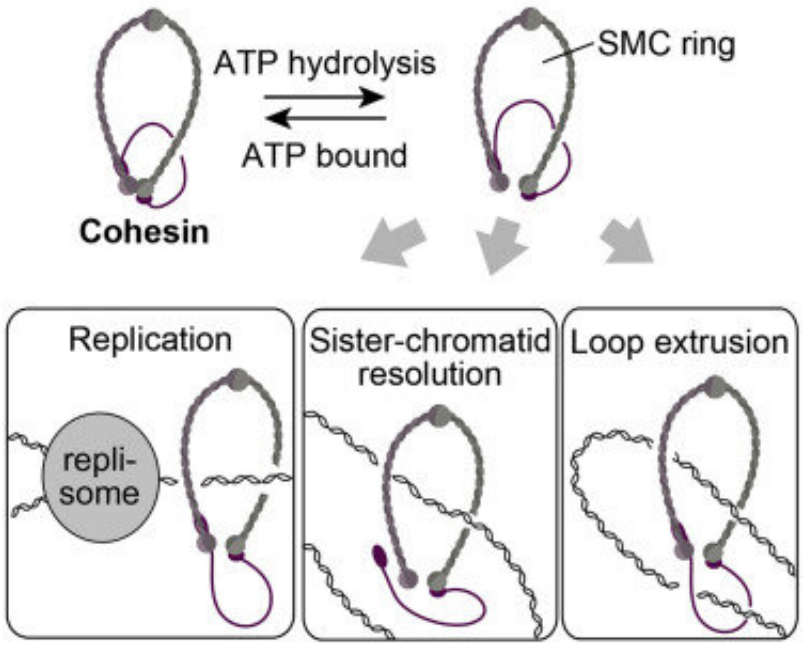

Graphical abstract

Scientists at Nagoya University, with colleagues at Kyoto University in Japan, have uncovered a mechanism that allows a protein complex to bind to DNA without impeding some of the important processes of cell division. Their findings, published in the journal *Cell Reports*, could further understandings of developmental disorders arising from mutations in the gene that codes for the complex.

DNA condenses during cell division to form structures called chromosomes that are formed of two identical copies, called sister chromatids. These sister chromatids are bound together by proteins called cohesins, until it is time for them to be pulled apart and directed into the newly formed cells. Scientists know quite a bit about the structure and functions of cohesin, but some questions remain. For example, cohesin binding to chromosomes should form a structural impediment to the process of DNA replication, so why doesn't it?

"We found that cohesin's ring needs to open for certain processes, like DNA replication, to progress," says Nagoya University chromosomal biologist Tomoko Nishiyama, who led the study.

Cohesin is a ring-shaped complex consisting of four subunits that can come together in various ways to form smaller rings. The researchers found that the energy-carrying molecule ATP triggers the opening of one of the rings. This facilitates the progressive replication of the DNA double helix .

Additionally, the scientists found that this ring needs to open for two other processes to occur: one involving chromosome segregation during cell division and another involving the formation of DNA loops. DNA looping brings segments that are far away from each other close together, which is important for regulating gene expression.

"Basically, cohesin needs to be dynamic on DNA in order for these processes to occur," says Nishiyama. "Changes in cohesin's shape affect the structure of the genome, and deficiencies in this function can cause cohesin-related genetic diseases called cohesinopathies."

The team next wants to further understand the molecular mechanisms of cohesin's involvement in DNA replication. They also want to improve understanding of cohesinopathies by investigating how cohesin regulates

genome structure.

More information: Ryota Sakata et al, Opening of cohesin's SMC ring is essential for timely DNA replication and DNA loop formation, *Cell Reports* (2021). DOI: 10.1016/j.celrep.2021.108999

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