CDB SEMINAR

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Thursday, June 9, 2011
16:00~17:00 A7F Seminar Room

Complete 3D kinetochore tracking reveals error-prone homologous chromosome biorientation during mouse oocyte meiosis

Summary

To achieve faithful segregation during cell division, all chromosomes must establish stable biorientation prior to anaphase. The detailed process by which chromosomes are bioriented and how biorientation is coordinated with spindle assembly and chromosome congression remain unclear. In this study, we performed high-resolution confocal live imaging of kinetochores and chromosomes for ~8 hours from NEBD to anaphase onset of the first meiotic division in mouse oocytes. This provided us to our knowledge the first complete 3D kinetochore tracking datasets throughout cell division. Our systematic quantitative analysis using this dataset showed that in the acentrosomal oocytes, chromosome congression forms a novel chromosome configuration, the prometaphase belt, which precedes chromosome biorientation and spindle elongation. The prometaphase belt is then transformed into the metaphase plate, by the chromosomes that invade the spindle center from the periphery. Concomitantly with spindle elongation, kinetochores start to be attached by microtubule bundles, inducing chromosome biorientation attempts, however, the initial attachment manner is predominantly lateral or merotelic. Due to these improper attachments, close to 90% of all chromosomes have to undergo one or more rounds of error correction of their kinetochore-microtubule attachments before achieving correct biorientation with amphitelic attachments. Our data provide quantitative evidences that homologous chromosome biorientation in mouse oocytes is a highly error-prone process, providing a possible explanation for the high incidence of aneuploid eggs observed in mammals including humans.

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