

Structure and Dynamics of Centromere-Specific Nucleosomes

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During metaphase sister centromeres are segregated by 600-800 nm. Separation progressively decreases along chromosome arms such that sister chromatids are tightly juxtaposed at ~10 kb from the centromere. The molecular glue linking sister chromatids, cohesin, is recruited to a 20-50 kb region surrounding the centromere at 3-to 5-fold higher levels than centromere-distal locations. A major paradox is the accumulation of cohesin at regions of separated sister DNA strands. Bloom Lab has found that cohesin (SMC3) is organized in a cylindrical structure surrounding interpolar microtubules in metaphase. We propose that pericentric chromatin is held together via intramolecular cohesion, resulting in a Holliday-type junction at the centromere. Changes in intra-or inter-molecular cohesion results in oscillations in the position of the centromere relative to the chromosome axis. The range of force generated by the microtubule is on the order of that required to alter the transition zone position and hence the spatial position of the centromere. The structure predicted by this model may represent the fundamental unit of the kinetochore across phylogeny.