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High Resolution Views of the Dynamic Interface between Mammalian Kinetochores and Microtubules

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Genomic stability requires proper chromosome alignment and control of cell cycle progression, which in turn are regulated by the dynamic interactions between kinetochores and microtubules (MTs). The kinetochore is composed of at least 60 proteins, and is localized at the primary constriction of chromosome. Molecular and structural studies have independently found that the kinetochore consists of three domains, with the middle domain, or outer plate, being essential for MT attachment. We have used electron tomography to determine the ultrastructure of the outer plate in the PtK1 cells prepared by high-pressure freezing and freeze-substitution (HPF/FS). We found that in the absence of MTs the outer plate forms a fibrous meshwork arranged into 50-75nm thick disc. The meshwork is constructed from crosslinked fibers that are relatively well-ordered and oriented parallel to the outer plate surface. This result is consistent with conclusions from previous biochemical analysis that most kinetochore proteins are rod shaped. Upon MT binding, the outer plate meshwork becomes more disorganized. Some of the fibers reorient along the direction of the long axes of MTs, while others radially associate with MT plus-ends. This report is the first detail description of kinetochore ultrastructure and its changes upon MT binding.