BMP signaling is required for cell cleavage in preimplantation-mouse embryos
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The mechanisms regulating cell division during development of the mouse pre-implantation embryo are poorly understood. We have investigated whether bone morphogenetic protein (BMP) signaling is involved in controlling cell cycle during mouse pre-implantation development. We mapped and quantitated the dynamic activities of BMP signaling through high-resolution immunofluorescence imaging combined with a 3D segmentation method. Immunostaining for phosphorylated Smad1/5/8 shows that BMP signaling is activated in mouse embryos as early as the 4-cell stage, and becomes spatially restricted by late blastocyst stage. Perturbation of BMP signaling in preimplantation mouse embryos, whether by treatment with a small molecule inhibitor, with Noggin protein, or by over-expression of a dominant-negative BMP receptor, indicates that BMPs regulate cell cleavage up to the morula stage. These results indicate that BMP signaling is active during mouse pre-implantation development and is required for cell cleavage in preimplantation mouse embryos.