

## **Movie captions**

### **Movie S1: Path of nuclear migration to the dorsal-anterior corner.**

An example of a nucleus that migrates to the anterior of the oocyte, then slides towards the dorsal side. 1 image was acquired every 1 min for 4 h (total 241 time points); the playback speed is 15 frames per second (fps). (3.2 MB)

### **Movie S2: The nucleus migrates with a posterior indentation.**

Egg chamber expressing Cam-RFP, which marks the nuclear envelope. The nucleus migrates from the posterior (right) to the anterior (left) of the oocyte with a prominent posterior indentation. 1 image was acquired every 4 min for 3 h; the playback speed is 10 fps. (1.5 MB)

### **Movie S3: In *Lis1* mutants, the nucleus migrates with a posterior indentation towards the anterior-dorsal corner of the oocyte.**

A *Lis1*<sup>E415</sup> mutant egg chamber expressing Dlic-GFP. 1 image was acquired every 2 min for 2 hours; the playback speed is 10 fps. (4.6 MB)

### **Movie S4: The nuclear indentation depends on microtubules.**

An egg chamber expressing EB1-GFP to label growing microtubules treated with the microtubule-depolymerising drug, colcemid. Acquisition was started approximately 1 min after the addition of colcemid. At the start of the movie, microtubules polymerise throughout the oocyte, with a strong focus of microtubule nucleation behind the nuclear indentation (arrow). As colcemid diffuses into the oocyte, microtubule polymerisation decreases and eventually stops, leading to the gradual disappearance of the indentation. 1 image was acquired every 2 s for 10 min; the playback speed is 30 fps. (3.1 MB)

### **Movie S5: Active centrosomes localise behind the nuclear indentation.**

An egg chamber expressing EB1-GFP was filmed for 2 minutes (2 frames/sec) at 0 min, 30 min, 1 hour and 1 h 30 min of nuclear migration, and the resulting movies were fused to play consecutively. As the nucleus migrates to the anterior, active MTOCs are localised between the nucleus and the posterior cortex of the oocyte. The playback speed is 30 fps. (9 MB)

### **Movie S6: Perinuclear centrosomes are recruited to the anterior-dorsal side of the nucleus at the end of migration.**

An egg chamber expressing Dlic-GFP to mark MTOCs. At the start of the movie, the nucleus has already reached the anterior cortex of the oocyte, but there is still a pushing force, as indicated by the posterior nuclear indentation. During the movie, the perinuclear centrosomes (marked by Dlic-GFP) move around the nuclear envelope to reach the

anterior oocyte cortex. Images were acquired once every 3 min for 5 h; the playback speed is 10 fps. (1.9 MB)

**Movie S7: Free centrosomes in the cytoplasm are recruited to the anterior-dorsal cortex.**

Egg chamber expressing Cam-RFP to label the nuclear envelope, and Sas4-GFP to mark the centrosomes. At the onset of migration, centrosomes are clustered behind the nuclear indentation. During migration, they disperse and move dynamically through the cytoplasm. As the nucleus reaches the anterior cortex of the oocyte, they become recruited to the anterior-dorsal side of the nucleus. Images were acquired once every 4 min for 2 h; the playback speed is 5 fps. (1.2 MB)

**Movie S8-11: The nuclear indentation depends on centrosomes.**

Egg chambers expressing Cam-RFP to visualise the nuclear indentation, and Sas4-GFP to mark the centrosomes. Centrosomes were bleached with a 405 nm laser for 5 s. Playback speeds are adjusted to 120x real time.

**Movie S8: Ablation of a centrosome cluster at the posterior of the nucleus abolishes the nuclear indentation.**

1 image was acquired every 30 s for 5 min; the playback speed is 4 fps. (820 KB)

**Movie S9: Ablation of the nuclear membrane at the site of the indentation has no effect on nuclear shape.**

1 image was acquired every 20 s for 5 min; the playback speed is 6 fps. (2.8 MB)

**Movie S10: Ablation of the anterior side of the nucleus does not affect the nuclear indentation.**

1 image was acquired every 10 s for 5 min; the playback speed is 12 fps. (924 KB)

**Movie S11: Ablation of one group of posterior centrosomes causes only part of the nuclear indentation to disappear.**

The remaining active centrosomes (marked by Sas4-GFP) still induce an indentation in the adjacent region of the nucleus. 1 image was acquired every 10 s for 5 min; the playback speed is 12 fps. (2 MB)

**Movie S12: Absence of centrosomes does not affect nuclear migration.**

A wildtype egg chamber expressing Cam-GFP (left) is compared to a *DSas-4<sup>S2214</sup>* mutant germline clone (right). In the mutant, the nucleus migrates normally to the anterior with a

typical posterior indentation. 1 image was acquired every 2 min for 2 hours; the playback speed is 10 fps. (1.6 MB)

**Movie S13: Nuclear migration in a *par-1* hypomorph.**

A *par-1*<sup>6323</sup>/*par-1*<sup>W3</sup> egg chamber expressing Dlic-GFP to mark the nuclear membrane and centrosomes. Some centrosomes lie anterior to the nucleus and induce an anterior nuclear indentation. They eventually move around the nucleus to fuse with the posterior centrosomes, leading to a broad nuclear indentation and movement of nucleus towards the anterior. 1 image was acquired every 4 min for 2 h; the playback speed is 5 fps. (1 MB)

**Movie S14: Quantification of microtubules hitting the nucleus.**

An example of a movie used to quantify the number of microtubules hitting the nuclear indentation. Red lines highlight microtubules that grow against the nuclear indentation. 1 image was acquired every 500 ms for 1 min; the playback speed is 10 fps. (9.4 MB)

**Movie S15: The nucleus fails to be released from the posterior tether in *grk* mutants.**

Although the nucleus has a prominent posterior indentation in *grk*<sup>2B6</sup>/*grk*<sup>2E12</sup> mutants (right panel) that is similar to the wildtype indentation (left panel), it fails to migrate to the anterior, indicating that it is tethered at the posterior (n=4). A slightly larger and hence older oocyte was selected for the *grk* mutant to ensure that it is at a stage at which the nucleus would have migrated to the anterior in wildtype. 1 image was acquired every 4 min for 3 hours; the playback speed is 5 fps. (1.2 MB)