

Cell Biological Analysis of the Embryogenesis in *Gonium* (Volvocales, Chlorophyta)

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Abstract:

Volvocine algae include various species from unicellular *Chlamydomonas reinhardtii* to multicellular *Volvox* with germ-soma division of labor and are thought to be the unique model for research of the evolution of multicellularity. Within the volvocine lineage, the evolution from flattened colony to spheroidal colony might have occurred in two independent lineages: Volvocaceae and genus *Astrephomene* (Goniaceae). After successive cell divisions during embryogenesis, volvocacean species undergo inversion, turning the cell layer of an embryo inside out to orient flagellar positions of the daughter protoplasts toward the outside, to form a spheroidal colony. The inversion is accompanied by the change in shape of daughter protoplasts and the movement of protoplasts relative to cytoplasmic bridges, which produce the driving force of cell sheet folding (Viamontes & Kirk 1977, Green et al. 1981). On the other hand, *Astrephomene* undergoes the rotation of daughter protoplasts during successive cell divisions to form a spheroidal cell layer, instead of inversion (Yamashita et al. 2016). However, details of the evolution of these cellular events involved in the two types of spheroidal colony formation (shape change, movement and rotation) are unclear based on previous studies on more ancestral volvocine algae with flattened colony such as *Gonium* (e.g. Hallmann 2006, Iida et al. 2013). Here, with an active strain newly established from a rice field in Japan, we observed in detail the cell biological event during the embryogenesis of *Gonium pectorale* using light microscopy time-lapse imaging as well as immunofluorescence microscopy of basal bodies with anti-CrSAS-6 antibody. Rotation of daughter protoplasts was not observed during successive cell divisions. After the successive cell divisions, the concave cell sheet of an embryo expanded gradually without significant cell shape change, which might be the phenomenon called ‘partial inversion’ in previous studies (e.g. Hallmann 2006, Iida et al. 2013). The present results suggest that the two different ancestors of Volvocaceae and *Astrephomene* might have newly invented the cellular mechanisms to form a spheroidal colony after the divergence from the ancestors of Goniaceae and *Gonium*, respectively.

References:

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