The polyclad flatworm perspective of spiral quartet cleavage.

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The Lophotrochozoans (or Spiralians) are an evolutionary interesting clade in which the majority of today's animal body plans is found. Despite their diverse appearance these mostly marine animals often share fundamental similarities such as free-swimming, planktonic larval stages and most iconically a stereotypic developmental pattern, commonly known as spiral cleavage. This striking similarity during the early development opens the door for comparative studies allowing us to better understand the evolution of these vastly different body plans found in the Lophotrochozoa. We focus on the comparative developmental biology of the marine flatworm *Maritigrella crozieri* by studying in detail its early development. We followed the development of *Maritigrella* from a fertilized egg into an advanced stage of the embryo consisting of hundreds of cells using 4d light-sheet microscopy. Based on our live-imaging data, we created a cell lineage of the early development, which contains information about the relative rate of blastomere divisions, as well as spindle position information during embryogenesis and were used for a comparison with other polyclad flatworms and spiralian taxa. Our results address some fundamental mechanisms of the spiral cleavage mode found in early cleavage of many Lophotrochozoans studied so far, namely equal versus unequal cleavers, the specification of the D-quadrant and the break from a radial into a bilateral symmetric embryo, initiated by micromere 4d that takes a key role in endomesoderm formation of many spiral cleaving embryos, including polyclad flatworms. Our study of the development of the polyclad flatworm *Maritigrella crozieri* could resolve conflicting evidence of the cleavage of the mesentoblast in polyclad flatworms, provides a new insight into the fundamental mechanisms of the early spiral cleavage form a polyclad flatworm perspective and provides comparative data that show both distinct and shared patterns with other Lophotrochozoan members and bring both polyclad suborders, based on shared similarities into a close relationship.