From cells to complete retinal tissues: teachings and applications of cellular reaggregates

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Cells from dispersed embryonic avian or mammalian retinae have the capacity to reaggregate in rotation culture, sort-out and self-organise into histotypic cellular spheres *(retinal spheroids)*, reconstituting a more or less complete neural network of all retinal layers. This exquisite phenomenon is based upon *in vitro*-proliferation of multipotent precursor stem cells and spatial organisation of their differentiating descendants. Depending on species (chick, gerbil, mouse), the retinal origin of cells (central, peripheral) and a defined molecular and cellular environment (e.g. growth factors) are decisive for the achieved internal architecture of spheroids. In this lecture, I will briefly review the history of the reaggregation approach, present our diverse retinal reaggregate models, and analyse roles of radial glial cells and several growth factors for successful retinal tissue regeneration. Retinal spheroids can teach us basic requirements and constraints for tissue (re-)construction, e.g. which cell types, which genes and what factors are required to form in a “cell-by-cell manner” particular parts of a normal retina. The possible applications of spheroids are widespread, incl. biosensoring for drug and pollution testing, replacement of animal experimentation, and reconstruction of retinal tissue *(tissue engineering)* from appropriate human stem cells.