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OriSha - Engineering the Origin of Human Shape: Defining Patterns and Axes in the Early Stage of 3D Pluripotency

The process by which the human organism takes shape is a fascinating longstanding challenge of modern biology and medicine. It is a complex path, called morphogenesis, with many protagonists who, working synergistically, define the location, in space and time, of different specialized cells in space and time within the organs to build their shape and structure. OriSha will provide an innovative technology that will allow to model in time and space the early and inaccessible phases of human morphogenesis, with particular attention on the human nervous system development.

The development of our brain is a highly ordered process, which originates from a cylindrical structure, called neural tube, starting from the third week of gestation. Modeling this morphological process using the existing three-dimensional models, called organoids, whose shape acquired by random self-assembly is almost spherical, is limited in the reconstruction of shapes and axes that are well defined in the human body.

OriSha will instead be able to create mini-neural tubes in vitro with a controlled shape, to reproduce the geometric constraints present in the human body, following all the phases of the development of the central nervous system. Thanks to a system of micro-channels made of hydrogel with multiphoton microscopy, it will be possible to model in time and space the appropriate microenvironment to implement the structural changes that the neural tube undergoes during its development.

OriSha, with its interdisciplinarity, will represent a fundamental resource for future research, allowing to study the mechanisms that occur during the morphogenesis of the nervous system, both in healthy and pathological conditions. OriSha will offer the opportunity to study neural tube malformations (e.g. spina bifida) with a resolution never seen before, investigating the potential risk factors and causes in order to develop new preventive therapies.

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