Microfluidics as a promising approach for modeling the human neuromuscular junction *in vitro*

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The neuromuscular junction (NMJ) is a specialized chemical synapse localized between the terminal branches of spinal motor neurons and skeletal muscle fibers. Over the past two decades, *in vitro* co-culture systems have been developed to replicate the NMJ, aiming to address concerns about existing animal models. However, due to the intricate nature of its highly specialized structure, in vitro modeling of the NMJ remains a challenging task. Recently, microfluidics has emerged as a promising advancement in this field, providing a solution that enables spatial and temporal control over different microenvironments by independently manipulating neural and muscle cell populations. By exploiting an *organ-on-a-chip* approach, we obtained a reliable and predictive in vitro human model of the NMJ under both physiological and pathological conditions. This set up opens up opportunities to study synapse deterioration in neuromuscular diseases and holds promise for advancing our understanding of NMJ-related pathologies."