

〈講 演〉

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細胞シート工学を用いた再生医療

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Cell Sheet Engineering for Regenerative Medicine

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Abstract

Cell-based therapies have generated significant interest as novel drug delivery systems with various human adult cell types used in treating different types of diseases. In particular, the field of tissue engineering has gained its success in early clinical trials of regenerative medicine using viable cells placed into biodegradable scaffolds. In contrast to that method, we have developed a new approach that uses cultured cell layers grafted from the temperature-responsive polymer, poly (*N*-isopropylacrylamide), that allows controlled attachment and detachment of living cells *via* simple temperature change. Using these cultured cell sheets harvested from the temperature-responsive surfaces, we have established so called “cell sheet engineering” to manipulate functional cell sheets to treat a wide range of diseases such as corneal dysfunction, esophageal cancer, tracheal resection, and cardiac failure. For example, to overcome the limits of conventional treatments for corneal surface dysfunction, oral mucosal cells expanded *in vitro* have been used as an alternative approach. While previous studies used various carrier substrates, our method allowed us to create carrier-free oral mucosal cell sheets that can be transplanted on the sites without sutures. The results from clinical trials demonstrate successful transplantation with the recovery of lost visual functions in all cases. Moreover, we also have developed methods to create layered and vascularized tissues for organ-like systems such as the heart and liver. This can be achieved by taking advantage of the unique characteristics of the cell sheets to generate three dimensional tissues composed of only cultured cells and their deposited extracellular matrix. Cell sheet engineering therefore provides a novel alternative approach for tissue based regenerative medicine.

Key words: cell sheet, tissue engineering, regenerative medicine, thermo-responsive surface, nano-thin film.