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Development of Noninvasive Method to Analyze Dynamic Changes of Matrix Stiffness and Elasticity Characteristics

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Abstract : One of the most important unsolved problems in modern medicine is the increase of chronic diseases that lead to organ dysfunction or even complete loss of function. Current methods of treatment do not result in decreased mortality and disability statistics. Currently, the best treatment for many patients is still transplantation of organs and/or tissues. Therefore, finding a way of correct artificial matrix biofabrication in case of limited number of natural organs for transplantation is a critical task. One important problem that needs to be solved is development of a nondestructive and noninvasive method to analyze dynamic changes of mechanical characteristics of a matrix with minimal side effects on the growing cells. This research was focused on investigating the properties of matrix as a marker of graft condition. In this study, the collagen gel with human primary dermal fibroblasts in suspension (60, 120, 240*103 cells/mL) and collagen gel with cell spheroids were used as model objects. The stiffness and elasticity characteristics were evaluated by a semiconductor laser autodyne. The time and cell concentration dependency of the stiffness and elasticity were investigated. It was shown that these properties changed in a non-linear manner with respect to cell concentration. The maximum matrix stiffness was observed in the collagen gel with the cell concentration of 120*103 cells/mL. This study proved the opportunity to use the mechanical properties of matrix as a marker of graft condition, which can be measured by noninvasive semiconductor laser autodyne technique.

Keywords : graft, matrix, noninvasive method, regenerative medicine, semiconductor laser autodyne
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