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Mechanical Properties of Young and Senescence Fibroblast Cells Using Passive Microrheology

Authors : Samira Khalaji, , Fenneke Klein Jan, Kay-E. Gottschalk, Eugenia Makrantonaki, Karin Scharffetter-Kochanek

Abstract : Biological aging is a multi-dimensional process that takes place over a whole range of scales from the nanoscopic alterations within individual cells, over transformations in tissues and organs and to changes of the whole organism. On the single cell level, aging involves mutation of genes, differences in gene expression levels as well as altered posttranslational modifications of proteins. A variety of proteins is affected, including proteins of the cell cytoskeleton and migration machinery. Previous work quantified the expression of cytoskeleton proteins on the gene and protein levels in senescent and young fibroblasts. Their results show that senescent skin fibroblasts have an upregulated expression of the intermediate filament (IF) protein vimentin in contrast to actin and tubulin, which are downregulated. IFs play an important role in providing mechanical stability of cells. However, the mechanical properties of IFs depending on cellular senescence or age of the donor has not been studied so far. Hence, we employed passive microrheology on primary human dermal fibroblasts from female donors with age of 28 years (young) and 86 years (old) as model of in vivo aging and human normal dermal fibroblast from 11-year old male with CPD 17-35 (young) and CPD 58-59 (senescence) as a model of in vitro replicative senescence. In contrast to the expectations, our primary results show no significant differences in the viscoelastic properties of fibroblasts depending on age of the donor or cellular replicative senescence.

Keywords : aging, cytoskeleton, fibroblast, mechanical properties
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