SPECKLE INTERFEROMETRY MONITORING OF TISSUE STRUCTURE MODIFICATION.

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Heating of cartilage with IR laser light is widely used in laboratory and clinical practice to solve different diagnostic, therapeutic and surgical problems. One of the promising directions in laser medicine is the controlled cartilage tissue reshaping as a result of laser-mediated local heating of modified tissue. The cartilage is a densely packed collagen-containing tissue with proteoglycan framework. It was shown that the cartilage reshaping is presumably based on thermally activated transition in proteoglycan aggregates, but it is very important to provide adequate heating conditions without serious thermal damage of extracellular matrix, such as collagen denaturation. One possible approach to the solution of this problem is the statistical analysis of the time-averaged speckle-modulated images of modified tissue samples. These images are formed as a result of the illumination of treatment zone by low-intensity light source with appropriate degree of spatial and temporal coherence (He-Ne laser or semiconductor laser).

In our experiments, the detection of He-Ne laser light diffusely reflected by a layer of thermally modified cartilage tissue was chosen to study the temperature-dependent dynamics of image-modulating speckles. The thermal treatment of samples was provided by Erbium fiber laser (1.56 μm). After IR laser radiation of samples the collagen denaturation was analyzed by comparative determination of hydroxyproline content in native and trypsin-treated tissue [1]. The speckle patterns corresponding to the central part of treating zone with the highest level of the surface temperature were captured in the course of laser treatment by the CCD-camera. All images were processed to obtain the function **contrast** (autocorrelation function). The temperature dependencies of the contrast were analyzed to characterize the behavior of the contrast during IR laser heating. It was found out that the contrast dramatically increases or decreases (depend on observation scheme) near the temperature of collagen denaturation. The rate of the degradation increased after heating above this temperature as it was shown by the biochemical method. So, the contrast is sensitive to collagen denaturation and can be used to control thermal treatment of cartilage tissues.

[1] J. F. Woessner // Archives of Biochemistry and Biophysics, 1961, v.93, p.440.