Tension tests and Optical Coherence Tomography of irradiated human hyaline cartilage

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Optical Coherence Tomography (OCT) have been used as a new method to evaluate the internal structure of irradiated human hyaline cartilage, which have been sterilized with gamma radiation for storage in tissue banks. However, high doses of radiation may cause several damages in the tissue, including a decrease of mechanical properties. Different of other kinds of imaging methods, such as optical and electron microcopy, OCT is a non-destructive method of imaging. In OCT, the images use a false color scale. The white color represents a backscattering photon above of upper threshold and the black color represents regions where there is no signal, or below lower threshold. The other colors follow the rainbow RGB pattern. Deep-frozen human costal cartilage, as well as preserved in high concentrations of glycerol (>98%), were irradiated with doses of 15, 25 and 50 kGy of gamma radiation. To verify changes in the resistance to tension after irradiation, the tests were carried out in the universal testing machine Instron with the cross-head set to move at 5 mm/min. We used an OCT system (OCP930SR - Thorlabs) with spatial resolution of 6 microns and with power of 2mW in the sample. Doses of 15 kGy increase the resistance to tension in both deep-froze and preserved in glycerol cartilage samples. On other hand, deep-frozen, when irradiated with 25 and 50 kGy, had a decrease of their mechanical behavior smaller than those preserved in glycerol and irradiated with the same dose. The OCT signal in the sample can be understood as the density of the matter. The results suggest that the backscattering increase according the dose, once the red regions in the samples increase of the superficial zone toward the center. In non-irradiated samples, the red region is a thin layer on the superficial zone. In samples irradiated with 15, 25 and 50 kGy, the red regions become greater than in non-irradiated samples, reflecting disarray on the collagen network caused by irradiation, what is related with decrease of tensile properties. Thus, the data obtained from OCT allow its use in studies of cartilage structure; however, more studies shall be done to determine with more precision the structure of biological tissues as cartilage.