Strain Sensitivity of Human Abdominal Fascia

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PURPOSE The information about mechanical properties of abdominal layers is important implications for the development of realistic mathematical model of synthetic implants. The aim of the study is to determine the influence of strain amplitude on visco-elastic properties of human abdominal fascia.

METHODS The investigation included 31 specimens of fascia transversalis (FT)(number of samples - 15) and umbilical fascia (UF) (number of samples - 16) taken from 7 donors. A sequence of relaxation tests were performed at strain rate 1,26 mm/s and strain amplitude ranging from 4 to 6 %. The duration of the test was 600 *s*. Initial and equilibrium stresses *T*, T_0, initial elastic modulus *E* and equilibrium modulus, $E_{eq,}$ normalized relaxation ratio ΔT which shows the reduction of the stress during relaxation process $\Delta T = \frac{(T_0 - T_{eq})}{T_0} * 100$ [%], as well as ratio VE = (1- E_{eq}/E) which reveals the viscous response of testing samples at applied strain were determined from relaxation curves.

RESULTS The maximum values of T_0, *E* and E_{eq} were achieved at 5% strain by FT and at 6% by UF. In the range of applied strains the visco-elastic properties of UF are more clearly demonstrated than those of FT. An increase of 2% in strain increases the normalized relaxation ratio of umbilical fascia by 20% and reduces normalized relaxation ratio of fascia transversalis by 3%. The viscous response of testing samples at applied strain were different – in chosen range of strain the transversalis fascia did not exhibit a dependence on amplitude of strain (the response is constant), while strain amplitude increases the values of ratio VE for UF . Analysing the effect of sample localization on material properties it was obtained that there is no statistically significant differences between values of parameters from FT and UF groups. The localization of human abdominal fascia (HAF) do not significantly affects tissue properties.

CONCLUSIONS The visco-elastic mechanical behavior of human abdominal fascia was characterized and compared at strain levels associated with physiologic loadings. It was shown that strain sensitivity of HAF in the chosen range does not depend on localization. Results presented here provides new data for an intrinsic material properties of fascia, which could be used in mathematical models of individual structures and properties of sheet-like layers of abdominal wall.