

# MICRO-MECHANICAL PROPERTIES OF ANNULUS FIBROSUS IN ANIMAL MODELS

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## Introduction

The mechanical properties of the intervertebral disc are determined by the architecture of the collagen fibers in annulus fibrosus [Pezowicz, 2006]. This paper present information about mechanical properties of annulus fibrosus lamellar tensile at the micro level. For this purpose, studies were conducted an animal model of non-degenerate annulus fibrosus.

## Material and Methods

In this work were used 6 anterior parts of intervertebral disc taken from lumbar spine of young pigs in age 9 month. From the multi lamellar blocks of annulus fibrosus were cut (in the plane of outer lamellar) sections 40–50 $\mu$ m in nominal thickness.

These sections were trimmed to remain mono-aligned area of tissue, which were then cut to create a microtensile samples (dimensions of 1.55 $\pm$ 0.44mm length, 2.50 $\pm$ 0.54mm width). Samples were stretched in two directions: parallel and perpendicular to collagen fibers alignment direction. Uniaxial tensile test was carried out on the special microtensile device. Samples were tested at a constant speed of 0.06 mm/s, until rupture. In order to behaviour comparable conditions tests, specimens were kept in NaCl medium [Żak, 2010].

## Results and Discussion

From non-linear characteristics stress-strain curves were determined: ultimate force and tensile strength ( $\sigma_{UTS}$ ) -Tab. 1.

Direction	Parallel	Perpendicular
$F_{UTS}$ [N]	1.10 $\pm$ 0.41	0.02 $\pm$ 0,01
$\sigma_{UTS}$ [MPa]	11.81 $\pm$ 3.92	0.25 $\pm$ 0.19

Table 1: Mechanical properties of micro samples stretched in two directions.

Depending on the direction of tensile test, samples revealed different breaking mechanisms (Fig. 1,2). As opposed to samples stretched in parallel direction, in transverse direction observed a slight increase in value which persists until breaking [Pezowicz, 2005]. Knowledge about spatial connections of the collagen fiber structure in annulus fibrosus is essential to understand the mechanism of

damage in intervertebral disc. Microtensile test results have confirmed the anisotropy of annulus fibrosus in animal model and indicated that direction has influence on the mechanical properties.

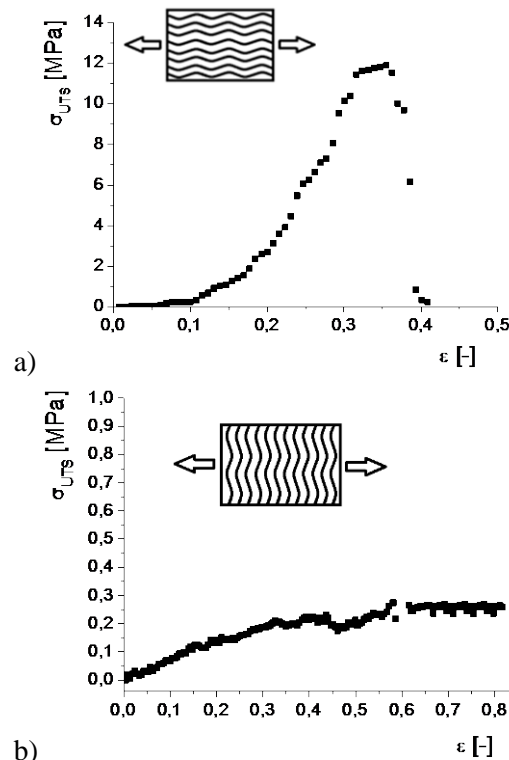


Figure 1: Typical stress-strain curve of single-layer samples stretched: a) in parallel direction, b) perpendicular direction to orientation of collagen fibers.

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## References

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