

TOWARDS A STRUCTURAL CONSTITUTIVE MODEL OF THE URINARY BLADDER WALL

Silvia Wognum and Michael S. Sacks

Under various pathological conditions such as spinal cord injury and diabetes, the routine function of the urinary bladder of storing urine and voiding becomes compromised. In addition to functional deficiencies, these pathologies are often accompanied by changes in bladder wall tissue morphology and mechanical properties. This suggests that a strong relation exists between tissue morphology, mechanical properties of the bladder wall and the health state of the bladder. A structural constitutive model of the urinary bladder wall is needed to clarify this relation and to understand how functional changes in various components produce observed changes in bladder function. For this, the multiaxial mechanical properties and quantitative morphology of intact bladder wall and of its components, i.e. of the smooth muscle cells and the extracellular matrix (ECM) are needed.

In addition to the mechanical properties of rat bladder wall tissue in the inactive state, in which muscle function is abolished, mechanical properties of the tissue in the passive (i.e. with muscle tone) and the active state are determined. Square test specimens from bladders from female Sprague-Dawley rats are tested in Krebs solution to a maximum stress level of 30 kPa in the biaxial testing device (see figures). Active contraction is achieved by adding carbachol to the testing bath. After mechanical testing, the tissue samples are decellularized and the ECM is mechanically tested separately. The orientation of collagen fibers in the ECM is determined using the small angle light scattering (SALS) technique on samples from decellularized rat bladders fixed at different volumes. This fiber distribution is compared with data of the smooth muscle orientation obtained previously.

