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BIOMECHANICAL PROPERTIES OF PELVIC LIGAMENTS

Hypothesis / aims of study

Pelvic organ prolapse (POP) constitutes a major health issue and significantly contributes to a decrease in the quality of life of aging women. A woman's lifetime risk for undergoing pelvic floor reconstructive surgery due to POP is estimated to be approximately 11%, rendering this diagnosis one of the most common indications for surgical treatment in women. Several risk factors contribute to the development of POP, but the genesis seems to be even more complex. Pelvic ligaments and especially the uterosacral ligaments are thought to play a pivotal role with regard to the statics of the pelvic floor supportive system [1].

In this study, we aimed to characterize and compare the biomechanical properties of uterosacral, cardinal, and round ligaments of 13 fresh women cadavers without POP. Our goal was to define the biomechanical properties of these ligaments in order to better understand their implication in the physiopathology of POP and pelvic reconstructive surgery.

Study design, materials and methods

This is an experimental study and pelvic ligaments were obtained from 13 fresh women cadavers without POP. The mean age was 83.4 years. In detail, we collected uterosacral, cardinal, and round ligaments. The cadavers were not formolized but frozen for conservation and unfrozen just before the dissection. In accordance with the previously established protocol [2], all samples were orientated and marked before being frozen in 0.9% salt solution at -18°C. The excised tissues were used to carry out uniaxial tension tests to the point of rupture as previously described [2]. Subsequently, the stress-strain curves were obtained and analyzed to characterize the biomechanical behaviour of the considered tissues. The mechanical response of the specimens before rupture was then studied. The fact of studying non-linear elasticity required at least the application of two parameters: C0 and C1 (Mooney-Rivlin model) [3]. The stress-strain curves allowed calculation of these values; C0 characterizes the stress-strain curve at its beginning phase (i.e. low strains), whereas C1 characterizes the form of the asymptote towards the end of the stress-strain curve (i.e. large strains).

Results

We were able to demonstrate a non-linear relationship between stress and strain and the biomechanical behaviour was hyperelastic (i.e. with large deformation of the pelvic ligaments examined) [Figure 1]. Individual reproducibility was good.

Importantly, uterosacral ligaments were the most rigid of the three studied structures, both, at low and large strain levels. Inter individual variations are probably due to the physiological differences among women.

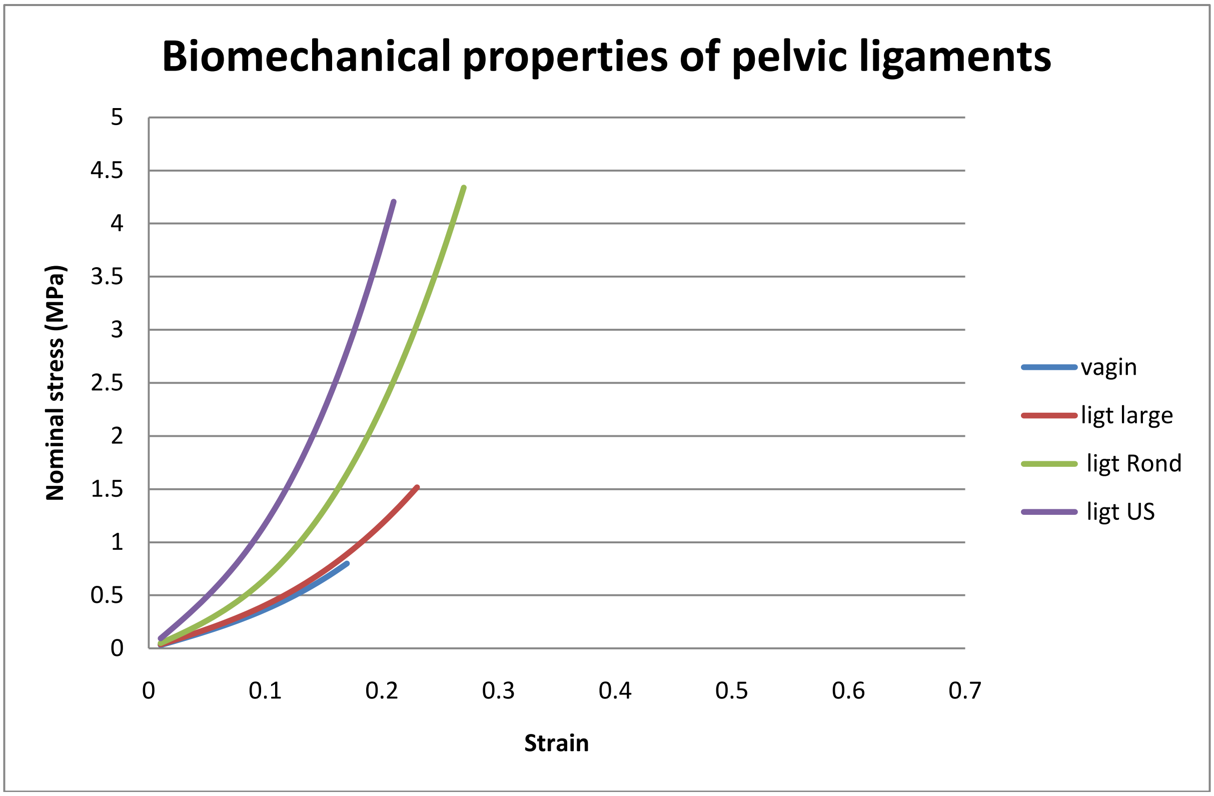
Interpretation of results

First, we defined biomechanical properties of pelvic ligaments in order to better understand the pathophysiology of POP. Uterosacral ligaments were the most rigid and least extendible ones. Consequently, they may a major contribution to pelvic static. Research on prolapsed tissue is ongoing and might help to further elucidate the biomechanical background of POP.

Concluding message

We were able to demonstrate that the biomechanical properties of uterosacral, cardinal, and round ligaments differ. Interestingly, the uterosacral ligament appears to represent the most rigid of the studied pelvic ligaments pointing to its important functional role for the pelvic statics.

Figure 1



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