Biomechanical properties of the prolapsed anterior vaginal wall in post-menopausal women

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Statement of Purpose:

To study the effect of tissue storage and transport on the biomechanical properties of freshly harvested human anterior vaginal wall (AVW) samples.

Methods:

Following IRB approval, a longitudinal full-thickness sample of redundant AVW from the site of lateral defect cystocele was excised on each side of the midline during cystocele repair (Stage III or IV) in post-menopausal women and compared to samples obtained in age-comparable controls with no symptoms or clinical findings of prolapse who underwent radical cystectomy for invasive bladder cancer. Samples (width ≥ 1cm; length ≥ 3cm) were marked to maintain orientation and prepared for testing within 2 hours of harvest. Samples were secured in a tensile test machine equipped with special jaws (Bionix 858, MTS systems, MN). Tissues were pre-loaded at 2.2 Newtons (N), then stretched at 0.5 mm/sec, continuing until irreversible deformation was observed. The pre-transition tensile strain, slope of the stress vs. strain curve (Young's modulus, Y), yield point (YP) and ultimate failure stress (F) were measured for each tissue strip. Two methods of tissue storage and transport were compared: method A denotes samples immersed in room temperature sterile normal saline; method B denotes samples placed on saline-soaked sterile gauze at room temperature without further hydration. To avoid bias, testing was performed independent of clinical information (age, hormonal status, stage of prolapse). Over 2 years, 41 patients provided samples analyzed bilaterally (7), and unilaterally [16 (A), 23 (B)]; three control samples (B) were also analyzed.

Results Obtained:

Except for one patient, closely comparable biomechanical findings (left versus right) were noted. Table 1 describes the biomechanical findings for prolapsed samples by hydration methods A and B, and for control samples.

Conclusions:

This study identified significant differences in biomechanical results based on the degree of hydration of the tissue: this is an important consideration for sample collection in future studies. The wetter samples (A) exhibited lower modulus and F compared to the moistened samples (B). Longer clinical follow-up will be necessary to determine the predictive relevance of these biomechanical findings on recurrence rates.

	Control	**Prolapse**		
	(B) *	**(A)**	**(B)**	
N	3	16	23	
Sample thickness (mm)	2.8±0.4**	3.2±1.2**	2.2±0.8**	NS
Pre-transition strain	0.002±.015	0.019±.05	0.221±0.09	$p<0.05$
Y (N/mm^2)	10.2±3.9	4.4±2.8	8.4±4.8	$p<0.001$
YP (N/mm^2)	0.1± 0.1	0.5±0.2	0.3±0.2	$p<0.02$
F (N/mm^2)	1.4±0.4	1.4±0.2	2.1±0.3	$p<0.03$

* (A) immersed (B) moistened

** Mean ± SD