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CORRELATION OF IN VIVO BIOMECHANICAL PROPERTIES OF THE VAGINAL WALL AND CLINICAL SEVERITY SCORES IN PATIENTS WITH AND WITHOUT PREVIOUS PROLAPSE SURGERY

Hypothesis / aims of study

There are not much data on in vivo biomechanical measurements of the vaginal wall. Epstein et al [(1)] examined the relationship of in vivo biomechanical properties of the vaginal wall in patients with and without prolapse. In that study, as having prolapse were considered patients in whom the leading edge descended beyond the hymenal ring. Measurements were done on a single point on the lateral vaginal wall 2 cm above the hymenal ring. They used the commercially available DermaLab skin probe (Cortex Technology, Hadsund, Denmark; dimensions: 2.0*1.5 cm). During measurement, the vaginal wall is subjected to an increasing aspiration pressure. It registers the time it takes the vaginal epithelium to pass through a 10 mm aperture as evidenced by an infrared light beam. This device however is not purposely designed for intravaginal use. It has a large aperture, so that compliant tissue could fill the cup prior to measurement. Also measurements are done at a single point, which on itself is not a reference point of the clinical POP-Q score [(2)] . Herein we aimed to perform site specific in vivo biomechanical properties with a purpose-designed suction device, derived from the Cutometer MPA 580 (Courage and Khazaka Electronic GmbH, Cologne, Germany). This device is designed for intravaginal use, has a length of 20 cm and the largest diameter of the device is 3 cm and a 6. In essence, it records vaginal wall displacement (strain) under a fixed aspiration pressure (stress) through an integrated optical system.

Study design, materials and methods

A total of 48 patients, in which we could obtain at least one recording, were included in this study. These were women referred for pelvic floor ultrasound examination for a variety of reasons. First, the degree of prolapse was staged according to the POPQ-classification, and categorized as stage I or less (not prolapsed) or stage II or more (prolapsed). Then vaginal biomechanical properties were measured using the device. One typical vaginal elasticity measurement consisted of a single cycle with an aspiration pressure of 300 mbar, an aspiration pressure comparable to dermal measurements. Both suction and relaxation time consist of 5 sec after an initial 10 sec pretime without aspiration. The measurements were taken at four places: two on the anterior vaginal wall, at point Aa and 5 cm above the hymenal ring (=Aa-2 cm), and two on the posterior wall, at point Ap and 5 cm above the hymenal ring (=Ap-2 cm). The Cutometer MPA580 software displays a series of plots and parameters (=recording), among which R0: firmness of the vaginal wall; R2: overall elasticity and R7: ratio of elastic recovery to the total deformation, which are representative for the entire measurement. After measurement, the recording was judged to be interpretable or not, based on its quality. If not, up to three attempts were made to obtain a better recording. In its absence, the entire measurement for this location was classified as failed. Further their medical records were searched for history of prolapse surgery. Descriptive statistics and factor analysis were done using, JMP®7 software (SAS Institute Inc., Cary, NC, 2007). Factor analysis allows to determine which experimental conditions affect the measurements in a significant way and which experimental conditions could be considered as irrelevant.

Results

The mean age of patients was 64,27 years (range:28-82 yrs). The summary statistics of these are displayed in Table 1. None of the correlations between clinical prolapse scores and the biomechanical measurement values (R0, R2, R7) were significant (p values not shown). Measurements within the same patient, at different sites, were significantly correlated (p>0.05).

Further we observed that measurements in patients previously operated for prolapse, as compared to those never operated for prolapse, were significantly different as demonstrated in table 2. Of note is that measurements in patients with a previous operation, measurements of all sites, even if unoperated, were comparable. However that number of sites was so low that no further statistics were run on it.

Table 1. Summary statistics.

	N	N measurements	Mean prolapse measured (cm)	Mean R0	Mean R2	Mean R7
Stage 0-I						
Aa	27	26	-2.62	1.41	0.55	0.07
Aa-2 cm/Ba*	26	25	-2.44	1.2	0.62	0.08
Ap	34	31	-2.47	1.52	0.47	0.07
Ap-2 cm/Bp*	30	29	-2.28	1.5	0.51	0.07
Stage II+						
Aa	21	20	0.5	1.42	0.45	0.07
Aa-2 cm/Ba*	22	21	1.38	1.61	0.51	0.08
Ap	14	14	0.43	1.54	0.45	0.09
Ap-2 cm/Bp*	18	17	1.12	1.25	0.56	0.08

**Clinical POP-Q measurement is at point Ba resp. Bp; biomechanical measurements were made at a point close to this, i.e. Aa-2 resp. Ap-2 cm.*

Table 2. Previous prolapse versus no previous prolapse surgery

	Previous prolapse surgery				No previous prolapse surgery				Correlation pre-postoperative (p value)		
	n	R0	R2	R7	n	R0	R2	R7	R0	R2	R7
Aa	14	1.08	0.61	0.08	32	1.56	0.46	0.07	0.0412*	0.2669	0.2373
Aa-2	13	0.96	0.70	0.1	28	1.6	0.50	0.08	0.0381*	0.1166	0.0665
Ap	13	1.1	0.60	0.1	31	1.7	0.40	0.07	0.0206*	0.0476*	0.064
Ap-2	13	1.16	0.61	0.1	30	1.5	0.49	0.07	0.165	0.2610	0.0586
All	15	1.07	0.63	0.09	33	1.59	0.40	0.07	<0.001*	0.0027*	0.007*

Interpretation of results

In this population, there was no correlation with POP-Q scores and vaginal biomechanical measurements. This was so for patients with and without stage II+ prolapse, however there were no patients with severe prolapse investigated. In those patients, measurements from one site were representative for the other tested sites. We further observed that measurements in previously operated patients, hence scarred vaginal tissue, were measurably different.

Concluding message

In this preliminary study different vaginal compliance could be measured in patients with and without previous surgery. This confirms a clinical impression that scarred vaginal tissue is less compliant. In other words, the current device can make such changes objective. Unfortunately we do at present have no information on the correlation of those measurements and (vaginal) function. If that would be correlated, compliance measurements may be functionally important, when following patients around the time of an operation.

Surprisingly, there was no correlation between the severity of POP (as evidenced by their POPQ score) and the biomechanical measurements. Further, in these patients, vaginal compliance was homogenous. So, whereas we expected abnormally compliant measurements in prolapse patients and specific sites, this was not the case. It is possible that compliance changes in the vaginal wall only become measurably different when there is grade III or IV prolapse. Unfortunately we did have only a few patients with stage III and none with stage IV disease in this sample. Further studies are underway.

References

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