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The long and short of it: anterior vaginal wall length before and after anterior repair

Carolyn W. Swenson, Angela M. Simmen, Mitchell B. Berger, Daniel M. Morgan, and John O. DeLancey

Department of Obstetrics and Gynecology, University of Michigan, L4000 Women's Hospital, 1500 E. Medical Center Dr., SPC 5276, Ann Arbor, MI 48109-5276, USA

Carolyn W. Swenson: scarolyn@med.umich.edu

Abstract

Introduction and hypothesis—Anterior vaginal wall length (AVL) is on average 6.1 ± 1.3 cm in women with normal support and lengthened in women with cystocele. We hypothesize that AVL is reduced after anterior repair and that women with larger cystoceles will have greater reduction in AVL.

Methods—Demographic, clinical, and surgical data were collected for women undergoing hysterectomy and anterior repair in whom intraoperative vaginal wall measurements had been made between November 2009 and April 2014. In the operating room, AVL was defined preoperatively as the distance from the hymenal ring to the anterior cervicovaginal junction at the hysterectomy incision site, and postoperatively, from the hymenal ring to the same location on the anterior cuff. During the anterior repair the fibromuscular tissues were plicated using an interrupted technique.

Results—Measurements were available for 40 women. Average age was 61.7 ± 10 years, median parity was 2.5 and median preoperative Pelvic Organ Prolapse Quantification System (POP-Q) point Ba was 3 cm distal to the hymen. On average, AVL was reduced after surgery by 2.5 cm. Mean postoperative AVL was similar to mean AVL in women with normal pelvic support (6.4 ± 0.8 cm vs 6.1 ± 1.3 cm, $p=0.15$). Longer preoperative AVLs had greater AVL change ($R^2=0.78$, $p<0.0001$).

Conclusions—In women undergoing anterior repair, mean AVL was reduced by 28 % and returned to the normal range after surgery. These data highlight a rarely discussed effect of anterior repair, which is restoration of normal anterior vaginal wall length.

Keywords

Anterior vaginal wall length; Anterior repair

Correspondence to: Carolyn W. Swenson, scarolyn@med.umich.edu.

Conflicts of interest

During the last 3 years, the University of Michigan received funding as partial salary support for research in which J.O. DeLancey was engaged from the following companies: American Medical Systems, Johnson & Johnson, Kimberly Clark, Procter & Gamble, and Boston Scientific Corporation. J.O. DeLancey also received an honorarium and travel reimbursement for delivering a lecture on recent research findings at Johnson & Johnson and does consulting work for Procter & Gamble. No conflicts of interest were declared for C.W. Swenson, A.M. Simmen, M.B. Berger, or D.M. Morgan.

Introduction

Up to one quarter of women in the United States report one or more symptomatic pelvic floor disorders, with a 12 % lifetime risk for surgery [1, 2]. Involved in approximately 80 % of surgical pelvic organ prolapse repairs, the anterior compartment is the most common site of prolapse, and the most common site of recurrence [3, 4]. It is commonly accepted that anterior colporrhaphy narrows a widened anterior vaginal wall, but the effect on anterior vaginal wall length (AVL) is unknown. Hsu et al. showed that although apical descent is the primary factor contributing to cystocele size, increasing vaginal length accounted for 30 % of anterior wall prolapse. Re-analysis of Hsu's data found that the AVL is 23 % longer in women with cystocele than in normal controls (7.4 ± 1.7 cm vs 6.1 ± 1.3 cm) [5].

The aim of our study was to determine whether vaginal length is altered in women undergoing anterior repair and hysterectomy. Furthermore, we sought to determine if women with longer preoperative AVLs undergo a greater degree of shortening after surgery.

Materials and methods

Demographic, clinical, and surgical data were collected for women undergoing hysterectomy and anterior repair in whom intraoperative vaginal wall measurements had been made between November 2009 and April 2014 at the University of Michigan. Approval was obtained from the University of Michigan's Institutional Review Board (HUM00089700). In the clinic, measurements were performed with patients in the low lithotomy position using the standardized Pelvic Organ Prolapse Quantification System (POP-Q) [6]. In the operating room, AVL was defined preoperatively as the distance from the hymenal ring to the anterior cervicovaginal junction at the hysterectomy incision site. The cervicovaginal incision was made in a circumferential fashion around the cervix and made just distal to the bladder reflection anteriorly. We did not utilize the technique of an anterior triangle along the vaginal wall for this incision. After the anterior repair was completed and before closing the vaginal cuff or tying up apical suspension sutures, AVL was again measured from the hymenal ring to the same location on the anterior cuff (Fig. 1). This measurement was considered the "postoperative" AVL. A native tissue anterior colporrhaphy and vaginal hysterectomy were performed on all women. During the anterior repair, the vaginal epithelium was sharply dissected off of the underlying fibromuscular tissues to within 1 cm of the external urethral meatus. The fibromuscular layer was then plicated using interrupted stitches of a delayed absorbable suture. Plicating sutures were placed in either a vertical or a horizontal orientation at the surgeon's discretion (Fig. 2). Placing the needle vertically through the tissue was intended to have the effect of reducing vaginal length. The excess epithelium was then trimmed and closed with a nonlocking running absorbable suture. Procedures were performed by one of two board-certified urogynecologists. Cases were divided into two groups based on preoperative AVL <8 cm or 8 cm. The value of 8 cm was chosen as it is approximately two standard deviations above the mean AVL of women with normal pelvic support [5].

Continuous variables were analyzed using paired *t* tests and linear regression was performed to determine correlations. Statistical analyses were generated using IBM SPSS® statistics software, version 20.0 (copyright 2011, IBM Corporation).

Results

Measurements were available for 40 women and the demographics are presented in Table 1. Average age was 61.7 ± 10 years and all women had anterior wall prolapse with a median maximal prolapse of 3.5 cm beyond the hymen. The distribution of preoperative and postoperative AVLs is shown in Fig. 3. Seventy-five percent of women had AVLs of 8 cm or greater preoperatively, while none did postoperatively. In all women, AVL was reduced after surgery and on average, AVL was shortened by 2.5 cm. Mean postoperative AVL was 6.4 ± 0.8 cm, similar to the mean AVL in women with normal pelvic support (6.1 ± 1.3 cm, $p=0.15$) [5]. Women with longer preoperative AVLs underwent greater change in AVL (2.9 vs 1.4 cm, $p=0.005$; $R^2=0.78$, $p<0.0001$; Table 2). Preoperative clinic POP-Q point Ba ($R^2=0.062$, $p=0.13$) and POP-Q point Aa ($R^2=0.031$, $p=0.30$) did not correlate with AVL change.

Discussion

We found that AVL is reduced by an average of 28 % in women undergoing anterior repair at the time of hysterectomy. To our knowledge this is the first report of the effect of anterior repair on vaginal length and adds to the existing literature regarding the relationship between cystocele and AVL. Although increased vaginal length has often been regarded as the cause of cystocele, recent studies suggest that it might actually be the result of a combination of factors acting on the pelvic floor. One theory is that a widened levator hiatus will generate a pressure differential between high intra-abdominal and low atmospheric pressure. When this pressure acts on anterior vaginal wall that is exposed beyond the hiatus, it places the vaginal wall under tension and generates a downward force, ultimately leading to increased AVL [7]. Although assessment of postoperative outcomes was beyond the scope of this study, we speculate that reducing excess anterior vaginal wall length might play an important role in the successful repair of a cystocele. Our data further show that women with longer preoperative AVLs had a greater reduction in vaginal length and the average postoperative AVL in our study was similar to that measured in women with normal pelvic support. These findings highlight a rarely discussed effect of anterior repair, which is restoration of normal AVL.

Although both surgeons in this study used a similar technique for performing anterior repair, a variety of techniques for native-tissue anterior colporrhaphy have been described [8–11]. These techniques vary by vaginal incision depth, length of anterior vaginal wall dissection, type of plication stitch used (vertically or horizontally oriented, interrupted vs running, or purse-string), and the type of suture used (absorbable, delayed-absorbable, permanent). The mechanical differences in these techniques are not often discussed, nor are the strategies behind using one technique vs another. In the procedure we describe, the decision to place the plication stitches in either a horizontal or a vertical orientation was determined by the surgeon. Our observation has been that vertically oriented stitches result in greater

shortening of the vaginal length than horizontally oriented stitches. This concept is demonstrated using a piece of stretchable fabric and the effect that either type of stitch has on the resulting fabric length (Fig. 4). Purposeful selection of a vertical plication stitch in a patient with vaginal elongation can help to restore normal vaginal length, while a horizontal plication stitch will help to maintain vaginal length in someone who does not require as much shortening. Recognition of these observations and surgical strategies is important to help to optimize our approach to native-tissue anterior colporrhaphy.

There are several limitations to our study. These cases came from a single institution and all surgeries were performed by one of two surgeons. Further work is needed to replicate these results in other centers and by other surgeons in order to increase generalizability. The technique used to measure pre-and postoperative AVL in this study is not a validated one and, as previously mentioned, anterior colporrhaphy performed by a technique other than that described in the study may yield different results. Surgeons placed the plication sutures in the horizontal or vertical orientation based on their best judgment and as this was not recorded in all operative notes, we were unable to determine which patients received which type of plication stitch. Furthermore, this study only assesses the change in AVL after anterior repair performed at the time of hysterectomy. Postoperative AVL was measured before vaginal cuff closure or tying up apical suspension sutures and should not be generalized to apply to isolated anterior repair or total vaginal length after apical suspension procedures for post-hysterectomy vaginal prolapse. Because the surgeons were performing the measurements, there was no way for them to be blinded to vaginal length and this could have potentially influenced the results. Finally, this was a small cohort and although we reached statistical significance, results may vary with a larger sample size. Our study is strengthened by the fact that all measurements and surgical procedures were performed by two experienced urogynecologists. Additionally, this is a descriptive study reporting novel results.

In summary, AVL is restored to the normal range after native tissue anterior repair and hysterectomy. Further investigation into how this observation might affect surgical outcomes could be important and may ultimately help to improve surgical technique for anterior colporrhaphy.

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References

1. Wu JM, Vaughan CP, Goode PS, Redden DT, Burgio KL, Richter HE, Markland AD. Prevalence and trends of symptomatic pelvic floor disorders in U.S. women. *Obstet Gynecol.* 2014; 123(1): 141–148.10.1097/AOG.0000000000000057 [PubMed: 24463674]

2. Wu JM, Matthews CA, Conover MM, Pate V, Jonsson Funk M. Lifetime risk of stress urinary incontinence or pelvic organ prolapse surgery. *Obstet Gynecol*. 2014; 123(6):1201–1206.10.1097/AOG.0000000000000286 [PubMed: 24807341]
3. Olsen AL, Smith VJ, Bergstrom JO, Colling JC, Clark AL. Epidemiology of surgically managed pelvic organ prolapse and urinary incontinence. *Obstet Gynecol*. 1997; 89(4):501–506.10.1016/S0029-7844(97)00058-6 [PubMed: 9083302]
4. Maher C. Anterior vaginal compartment surgery. *Int Urogynecol J*. 2013; 24(11):1791–1802.10.1007/s00192-013-2170-3 [PubMed: 24142055]
5. Hsu Y, Chen L, Summers A, Ashton-Miller JA, DeLancey JO. Anterior vaginal wall length and degree of anterior compartment prolapse seen on dynamic MRI. *Int Urogynecol J Pelvic Floor Dysfunct*. 2008; 19(1):137–142.10.1007/s00192-007-0405-x [PubMed: 17579801]
6. Bump RC, Mattiasson A, Bo K, Brubaker LP, DeLancey JO, Klarskov P, Shull BL, Smith AR. The standardization of terminology of female pelvic organ prolapse and pelvic floor dysfunction. *Am J Obstet Gynecol*. 1996; 175(1):10–17. [PubMed: 8694033]
7. Yousuf A, Chen L, Larson K, Ashton-Miller JA, DeLancey JO. The length of anterior vaginal wall exposed to external pressure on maximal straining MRI: relationship to urogenital hiatus diameter, and apical and bladder location. *Int Urogynecol J*. 2014; 25(10):1349–1356.10.1007/s00192-014-2372-3 [PubMed: 24737299]
8. Nichols, DH.; Randall, CL. Vaginal surgery. 4. Williams & Wilkins; Baltimore: 1996.
9. Te, Linde RW.; Rock, JA.; Thompson, JD. Te Linde's operative gynecology. 8. Lippincott-Raven; Philadelphia: 1997.
10. Walters, MD.; Walters, MD. Urogynecology and reconstructive pelvic surgery. 2. Mosby; St. Louis: 1999.
11. Wheelless, CR. Atlas of pelvic surgery. 2. Lea & Febiger; Philadelphia: 1988.

Fig. 1.

a–c Preoperative measurement of the anterior vaginal wall. **a** An Allis clamp is placed on the anterior cervix and the tip of a ruler positioned at the anterior cervicovaginal junction where the hysterectomy incision will be made. **b** The uterus is taken off of traction and the ruler is kept flush on the anterior vaginal wall to make the measurement. **c** A clamp is placed on the ruler to mark the external urethral meatus and the length of the anterior vaginal wall determined. **d, e** Postoperative measurement of the anterior vaginal wall. **d** After the anterior repair is performed and before closure of the vaginal cuff or tying up apical suspension sutures, the end of the ruler is placed at the top of the anterior vaginal wall. **e** After placing the ruler flush against the anterior vaginal wall, a clamp is placed on the ruler at the level of the external urethral meatus and the length of the anterior vaginal wall determined

Fig 2.

During anterior colporrhaphy, plication of the fibromuscular layer in two different orientations. **a** Horizontally (side-to-side), which would act to maintain vaginal length, and **b** vertically (top-to-bottom on the patient's left side (shown) and then bottom-to-top on the contralateral side), which would have the effect of a greater reduction in vaginal length

Fig 3. Comparison of pre- and postoperative anterior vaginal wall lengths in women undergoing hysterectomy and anterior repair. Each line connects a data point on the *left* indicating the preoperative length with the postoperative length to the *right* so that the slope represents the change in anterior vaginal wall length in each patient

Fig 4.

Demonstration of how orientation of the plication stitches during anterior colporrhaphy can help to maintain or shorten vaginal length. **a** Two typical plicating sutures where the needle inserts into point 1 and exits the tissue at point 2; then it is inserted again at point 3 and exits at point 4. **b** When tied, the entrance and exit points (*red dots*) are brought together transversely but not vertically, resulting in reduced width but not length. **c** A suture similar to a horizontal mattress is shown. **d** Tying this suture results in all four points being brought together in both the transverse and the vertical direction, thereby reducing both the length and the width

Table 1

Demographics and preoperative measurements for women undergoing hysterectomy and anterior repair

Variable	N=40
Age, years	61.7±10.0
Parity	2.5 (1–8)
Body Mass Index, kg/m ²	27.9±3.7
POP-Q	
Point Aa, cm	1.0 (–1–3)
Point Ba, cm	3.0 (–1–8)
Point Bp, cm	–2.0 (–3–6)
Point C, cm	–1.0 (–6–8)
Maximal prolapse, cm	3.5 (0–8)

Data presented as mean± standard deviation or median (total range)

POP-Q Pelvic Organ Prolapse Quantification System

Table 2

Anterior vaginal wall length (AVL) in women undergoing hysterectomy and anterior repair

	Preoperative AVL, cm	Postoperative AVL, cm	<i>p</i> value [*]	AVL change, cm
All subjects, <i>N</i> =40	8.9±1.7	6.4±0.8	<0.001	2.5
Preoperative AVL				
<8 cm, <i>n</i> =10	7.0±0.7	5.6±0.8	<0.0001	1.4
8 cm, <i>n</i> =30	9.5±1.5	6.6±0.6	<0.0001	2.9 ^{**}

Data presented as mean±standard deviation

^{*} *p* value calculated using a paired *t* test^{**} Comparison of the <8 cm group and the 8 cm group, *p*=0.005