ROLE OF THE FOUR-CORNER BLADDER NECK SUSPENSION TO CORRECT STRESS INCONTINENCE WITH A MILD TO MODERATE CYSTOCELE

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ABSTRACT

Objectives. Women undergoing four-corner bladder neck suspension were evaluated for subjective and objective results of the procedure. Patients were evaluated for continence, prolapse, and symptomatic status postoperatively.

Methods. Forty-seven women underwent four-corner bladder neck suspension for moderate cystocele with (44) or without (3) stress urinary incontinence. Mean and median follow-up were 37 months (range 15 to 80). To assess results of the four-corner bladder neck suspension, two sets of outcome measures were used (subjective questionnaire, including patient satisfaction, and objective physical examination, with standing voiding cystourethrogram) to compare pre- and postoperative data.

Results. At the time of follow-up, 25 patients (53%) reported no incontinence, 14 (30%) reported one incontinent episode per week, and 8 (17%) reported daily loss of urine. Twenty-seven (57%) had grade I or grade II cystoceles on follow-up examination and voiding cystourethrogram; however, only 12 (26%) experienced recurrent prolapse symptomatology. Overall patient acceptance of the procedure was high (70%).

Conclusions. The four-corner bladder neck suspension is an effective option in the management of moderate cystocele. Copyright 1997 by Elsevier Science Inc.

The surgical management of stress urinary incontinence (SUI) is influenced by the degree of cystocele. The goal of surgery is anatomic correction of the cystocele and elimination of stress incontinence.

The Kelly plication reapproximates the anterior vaginal wall and underlying tissues immediately beneath the bladder base, but it is associated with recurrent incontinence in 50% to 80% of women. Standard bladder neck suspensions, such as the modified Pereyra and Marshall-Marchetti-Krantz, provide early successful results for SUI in 80% to 90% of women; however, these procedures do not address significant cystoceles. The Burch suspension corrects both SUI and a moderate cystocele, with success rates varying from 63% to 98% at 12 to 24 months of follow-up.

The four-corner bladder neck suspension has gained popularity as a transvaginal technique for surgical management of SUI associated with a moderate cystocele. As described by Raz et al., the initial results in 107 women with a mean follow-up of 24 months revealed a 94% subjective correction of SUI and a 98% correction of cystocele on physical examination. Minimal complications were noted. However, no results in that patient population were reported regarding subjective patient evaluation or objective findings of the degree of cystocele correction by postoperative standing voiding cystourethrogram (VCUG).

The goal of this study was to assess the long-term postoperative results of the four-corner procedure objectively. Two outcome measures were chosen: first, subjective symptoms and patient satisfaction (as measured by questionnaire response obtained by an independent examiner); and second, objective results as measured by physical examination performed by an independent third-party examiner and radiographic findings (that is,
views were obtained. Descent of the bladder base beneath the presence of urethral hypermobility and contrast loss per urethral efflux was performed, using medium fill rate of 50 to 80 cc/min.

A standard bladder neck suspension was evaluated for minimal defects of the bladder base. The mean age was 58 years (range 35 to 86). Twenty-eight (60%) of the women were postmenopausal and eight (17%) were on estrogen supplementation. Mean gravidity was 3 and mean parity was 2.5. Fourteen women had previous hysterectomy, including 7 retroperitoneal procedures, 3 modified Pereyra bladder neck suspensions, 1 anterior repair, and 1 Gittes procedure. The mean time since the prior procedure was 4.2 years. Four of these procedures failed within the first year after surgery.

Pelvic examination with bimanual palpation was performed to exclude uterine or adnexal masses. Incontinence associated with urethral hypermobility was also recorded. No woman with intrinsic sphincteric deficiency was included in this study. In addition, the presence and degree of cystocele, rectoceles, and uterine support (or vaginal apical support if posthysterectomy) at rest and with straining were recorded. A standing vaginal examination was performed in patients with uterine descensus and when otherwise indicated. On physical examination, cystoceles were graded as grade I, minimal descent; grade II, descent of bladder base to the introitus with straining; and grade III, descent of the bladder base to the introitus at rest. Uterine descensus was categorized as minimal, prolapse to upper third of vagina with straining; moderate, descent to middle third of vagina with straining; and severe, descent to lower third of vagina or introitus with straining. No patient had severe uterine prolapse on initial examination.

The pelvic examination was repeated at follow-up with the patient in the supine and standing positions to assess the factors delineated above. Focused urologic examination of the perineum and lower extremities evaluated reflexes, sensation, and motor functions.

Urodynamic evaluation (UDE) was performed with a 7F dual-lumen urodynamc catheter for simultaneous infusion and intravesical pressure recording. An 8F rectal catheter was used to record intra-abdominal pressure. Water cystometry was performed, using medium fill rate of 50 to 80 cc/min. Methods and terms complied with International Continence Society standards.

All women underwent preoperative standing VCUG under fluoroscopic control. Anteroposterior and lateral views were taken at rest and with strain, with the Foley catheter in place and the bladder full. Then, after catheter removal, voiding views were obtained. Descent of the bladder base beneath the lower margin of the symphysis pubis (which characterizes cystoceles) was measured on anterior straining views. The presence of urethral hypermobility and contrast loss per urethra was also scrutinized on the VCUG.

Surgery

All women underwent four-corner bladder neck suspension as previously described. The indications for surgery were moderate cystocele and stress incontinence in 44 women and symptomatic moderate cystocele alone in 3 women.

Briefly, under general anesthesia, the patient was placed in the dorsal lithotomy position. After insertion of a Foley catheter, the vaginal wall was infiltrated with normal saline along two parallel incisions from the bladder neck to 2 to 3 cm from the cervical os.

Next, dissection on each side of the bladder neck proceeded laterally to the endopelvic fascia, which was perforated at the undersurface of the pubic ramus on either side. The retroperitoneal space was developed on each side with finger dissection from the ischial tuberosity to the symphysis pubis.

Using No. 1 polypropylene suture, helical bladder neck suspension sutures were placed on either side of the bladder neck, incorporating full thickness of the anterior vaginal wall excluding the epithelium. Next, No. 1 polypropylene sutures were placed high in the vagina, incorporating the cardinal ligament complex (if the uterus was still present) or the vaginal cuff (when posthysterectomy; Fig. 1).

With the bladder drained, all four sets of sutures were transferred suprapublically with a ligature carrier. After the administration of intravenous indigo carmine, cystoscopy was performed to exclude intravesical suture and confirm bilateral ureteral efflux. The vaginal incisions were closed with 1/0 absorbable sutures. The polypropylene sutures supporting the bladder neck were anchored either in the rectus fascia (n = 37) or the bone (n = 10) and tied with minimal tension to return the proximal urethra and bladder neck to a neutral position. The sutures incorporating the cardinal ligament complex were secured to the rectus fascia and tied with minimal tension.

Follow-up Assessment

All women underwent repeat history and physical examination by a physician not involved with the initial care of the patient. The mean and median time since surgery was 37 months (range 15 to 80).

The questionnaire included subjective assessment, such as the presence of urinary loss and the number and type of pads used. A pre- and postoperative pad score was calculated for each patient, using the following scoring system: 0, no pads; 1, occasional pad; 2, one to two pads per day; and 3, more than two pads per day.

The presence of the following symptoms was also assessed: stress incontinence, urgency or urge incontinence, dyspareunia, and pelvic prolapse symptoms (perineal pressure or vaginal mass). In addition, the patient was asked to rate her continence and satisfaction based on an analog rating scale of 1 to 4 (1, much better; 2, better; 3, same; and 4, worse). Each patient was also asked if she would have the procedure performed again. As part of this clinical study, 41 of the 47 women underwent follow-up standing VCUG with evaluation for the presence of any cystocele.
Follow-up urodynamic evaluation was performed in those women with significant urgency or SUI postoperatively (6 patients).

**STATISTICS**
McNemar’s test compared overall change between pre- and postoperative pad requirement, symptoms, physical examination findings, and results of urodynamic testing. Fisher’s exact test analyzed independent factors such as prior hysterectomy or bladder neck suspension procedures for their effect on outcomes. The paired t test compared pre- and postoperative descent of the bladder base as determined by anteroposterior views on straining from the VCUG. Statistical significance was established at $P < 0.05$.

**RESULTS**
Results of pre- and postoperative physical examination are recorded in Table I. Significant improvement occurred in all aspects of prolapse ($P < 0.05$) except for uterine descensus, which showed a tendency toward exacerbation postoperatively. Twenty women (43%) had no cystocele and 19 (40%) had grade I cystocele on postoperative examination (Table I). As preoperative cystocele grade increased, there was less chance of complete anatomic correction on postoperative physical examination and VCUG. Two women had enteroceles on follow-up examination. Eight of 30 women with a uterus developed complete uterine descensus postoperatively; this occurred at more than 12 months postoperatively in all cases.

Forty-one women underwent postoperative standing VCUG with anteroposterior views at rest and with straining on fluoroscopy for objective evaluation of cystocele correction. Bladder base descent below the pubic bone on the anteroposterior view on straining significantly decreased from 1.85 cm (SD 2.18) to 0.99 cm (SD 1.96) ($P = 0.0194$, Table II). Despite the decrease in descent on postoperative VCUG, cystocele grade (as determined by physical examination) was underestimated by VCUG.

All women underwent preoperative UDE. Thirty-six women (77%) had demonstrable SUI. Seven (15%) had urodynamic evidence of detrusor instability and SUI, and 3 (6%) had sensory instability. Six women underwent postoperative UDE. Three women had persistent SUI, 1 had de novo detrusor instability, and 1 had persistent detrusor instability. Two women had no demonstrable SUI or detrusor instability on follow-up UDE. Because of the small number of women undergoing follow-up UDE examination, conclusions cannot be drawn regarding postoperative urodynamic results.

With a mean follow-up of 37 months (range 15 to 80), 25 (53%) of the women reported total continence. Fourteen (30%) experienced occasional incontinence (once per week), and 8 (17%) reported daily loss of urine. Twenty-eight patients (60%) required no pads at follow-up. Preoperatively, 29 (62%) of the women used more than two pads preoperatively; postoperatively, only 5 women (11%) used more than two pads (light to moderate pads). The pad score decreased from a mean of 2.2 preoperatively to a mean of 0.7 postoperatively. Table III compares pre- and postoperative symptoms. Significant decreases ($P < 0.05$) occurred in all categories of incontinence. No correlation between preoperative grade of cystocele and postoperative recurrence of stress incontinence was noted (3 of 18 grade I, 4 of 20 grade II, 2 of 9 grade III). Thirty-one women (66%) noted pelvic prolapse symptoms preoperatively; only 12 (26%) noted prolapse symptoms at follow-up. Only seven of the women with recurrent cystoceles had symptoms related to pelvic prolapse. Recurrent urinary incontinence and prolapse symptoms were identified within 18 months after surgery.

Nine of the 47 women (19%) required subsequent surgery to correct vaginal prolapse or incontinence. Two women had formal cystocele repair, 2 had enterocoele repair, 3 had subsequent hysterectomy due to uterine prolapse, and 2 had subsequent anti-incontinence surgery (one retropubic suspension and one transvaginal suspension for recurrent bladder neck hypermobility associated with stress incontinence).

The independent variable of prior hysterectomy before four-corner bladder neck suspension was evaluated for effect on symptomatic, physical examination, and radiographic outcomes. No statistically significant difference ($P < 0.05$) was noted in any of the outcome parameters between those women who had undergone prior hysterectomy (33 of 47) and those who had not (14 of 47).

The second independent variable analyzed was the effect of prior incontinence surgery on the

**TABLE I. Comparison of pre- and postoperative pelvic examinations ($n = 47$)**

<table>
<thead>
<tr>
<th>Physical Finding</th>
<th>Preoperatively (%)</th>
<th>Postoperatively (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cystocele</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No cystocele</td>
<td>0</td>
<td>20 (43)</td>
</tr>
<tr>
<td>Grade I</td>
<td>18 (38)</td>
<td>19 (40)</td>
</tr>
<tr>
<td>Grade II</td>
<td>21 (45)</td>
<td>8 (17)</td>
</tr>
<tr>
<td>Grade III</td>
<td>8 (17)</td>
<td>0</td>
</tr>
<tr>
<td>Enterocele</td>
<td>3 (6)</td>
<td>2 (4)</td>
</tr>
<tr>
<td>Vault prolapse</td>
<td>1 (2)</td>
<td>0</td>
</tr>
<tr>
<td>Rectocele (de novo)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Uterine descensus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>lower one-third of vagina</td>
<td>0</td>
<td>8 (17)</td>
</tr>
</tbody>
</table>
same outcome parameters. The only statistically significant outcome factor was the presence of a higher rate of postoperative urge incontinence in those women who had undergone prior incontinence procedures as opposed to those who had not (P < 0.013).

When asked for a subjective rating of their overall status after the four-corner procedure, 43 women (92%) felt much better or better, 2 (4%) were the same, and 2 (4%) were worse after surgery. Thirty-one of 31 women with preoperative prolapse symptoms reported their prolapse symptoms were improved or resolved. Three of 6 women with preoperative dyspareunia noted resolution of this symptom postoperatively.

Overall, 33 (70%) of the women were satisfied with their continence status and prolapse repair and would undergo four-corner bladder neck suspension again. Of the 30% who would not undergo suspension again, recurrence of either urinary incontinence or prolapse symptoms was the main reason for dissatisfaction. Dissatisfaction was secondary to recurrent SUI in 4 women, recurrent prolapse symptoms in 3, coexistent SUI and prolapse in 3, and urgency in 4.

**COMMENT**

The four-corner bladder neck suspension is a reasonable surgical alternative for the management of a moderate cystocele associated with SUI. This study identified several unique points regarding subjective and objective outcome parameters in this group of patients.

The four-corner procedure had an 85% success rate at mean 3-year follow-up with regard to the subjective cure of SUI. This rate compares favorably with success rates of 75% at 3.5 years reported for the modified Pereyra bladder neck suspension by Kelly et al.9

Significantly, symptoms of pelvic prolapse were reduced from 66% of women preoperatively to 26% postoperatively. Dyspareunia also resolved in 3 of 6 patients with this preoperative complaint. Symptomatic prolapse was more pronounced in those patients with larger cystoceles (that is, grade III). However, only 43% of women had complete anatomic correction of their cystocele on physical examination by an independent examiner. The VCUG tended to underestimate the postoperative grade of cystocele, as compared with physical examination. This underestimation occurred on both pre- and postoperative comparisons of VCUG and physical examination. The disparity between the cystocele grade on physical examination compared with that obtained by VCUG raises significant concern regarding the reliance of preoperative staging on VCUG alone. The underestimation of the degree of cystocele on VCUG may be related to a suboptimal straining effort that results in less bladder descent on the x-ray film than appreciated on physical examination. Therefore, the usefulness of VCUG in the diagnostic evaluation of a moderate cystocele must be reconsidered.

The 57% rate of cystocele recurrence in this study is significantly higher than the 2% previously reported for transvaginal four-corner sus-
pension or the 10% reported for abdominal cystocele repairs. Miyazaki reported a 59% recurrence rate when evaluating a group of women undergoing four-corner bladder neck suspension with grade IV cystoceles at a mean of 3.5 years. In our view, large grade IV cystoceles should not be managed with the four-corner suspension. Our current management of grade IV cystoceles is formal repair with a bladder neck suspension.

Our 57% rate of cystocoele recurrence may be related to the objective nature of follow-up with an impartial examiner performing the pelvic examination and grading the cystocoele with longer follow-up than previously reported. Cystocoele recurrence may be due to the upper four-corner sutures tearing loose from the cardinal ligament complex or apical cuff scar. The cardinal ligament complex may become attenuated with time, may be inadequately incorporated at the time of initial surgery, or may be damaged by suture laceration or tension-related suture pull-through.

Another important finding is the occurrence of postoperative significant uterine prolapse in 8 of 33 women. In addition, 3 women underwent postoperative vaginal hysterectomy for uterine prolapse after the four-corner procedure. Explorations for this finding may include a weak cardinal ligament complex, which potentiates loss of structural uterine support. Thorough preoperative physical examination, both supine and standing, must be performed to exclude significant uterine descensus in association with a moderate cystocoele. When uterine descensus is noted, consideration should be given to vaginal hysterectomy in a postmenopausal patient. However, in this study, preoperative cystocoele grade could not be correlated with the development of uterine prolapse in 7 of 8 patients with uterine prolapse at follow-up.

No significant difference was noted between any subjective or objective outcome parameters comparing women with or without prior hysterectomy. Because 57% of women had some degree of cystocoele postoperatively, specific concern regarding the integrity of the four-corner repair in women after hysterectomy, compared with women who still had a uterus, is unfounded.

Prior failed incontinence procedures have been shown to decrease success rates in standard incontinence surgery. However, in this group, the only factor that was significantly different between those women with and without prior incontinence surgery was the development of postoperative urge incontinence. The incidence of postoperative urgency was much higher in the patients who had undergone a prior procedure, despite a similar incidence of urgency in both groups preoperatively. No other outcome factor, including resolution of SUI and correction of cystocoele, was adversely affected by prior incontinence surgery. Therefore, a history of prior anti-incontinence surgery should not dissuade the physician from considering four-corner repair in the appropriately selected patient. The best candidate for this procedure is a patient without intrinsic sphincter deficiency, who has a mild to moderate degree of cystocoele and who has no evidence of significant uterine or vault prolapse.

Patient satisfaction with the four-corner repair was high, with 92% of patients reporting a better or much better subjective status postoperatively and 70% reporting the willingness to repeat the procedure. As expected, those patients most satisfied were cured of their SUI.

A potential methodologic concern is the use of a questionnaire response to evaluate symptoms without urodynamics. Additionally, the use of data from a nonvalidated questionnaire may not completely reflect patient attitudes. Validated testing methodologies, which are being developed, are needed to enhance the accurate reporting of outcome data.

In summary, the four-corner bladder neck suspension is associated with acceptable long-term postoperative continence rates. However, a significant percentage of women had recurrent cystocoele, although improved from their preoperative status. Postoperative uterine prolapse was noted in a subgroup of patients undergoing the four-corner procedure. Patient acceptance of this procedure was high.

CONCLUSIONS

This study presents a 3-year mean follow-up of the four-corner bladder neck suspension using both a questionnaire and an objective investigation by a neutral third party. With increasing emphasis on outcomes data, patient acceptance of any surgical procedure for the management of urinary incontinence or pelvic prolapse must be considered. With a 3-year mean follow-up, the four-corner bladder suspension provides satisfactory cure of SUI. Symptoms of pelvic prolapse are also improved after this procedure, although anatomic cystocoele persists in a significant percentage of the women.

Postoperative uterine prolapse is a finding of concern, but apparently without impact on the anterior vaginal wall support achieved by the four-corner bladder neck suspension. The mechanism for this prolapse is not known; however, the presence of uterine prolapse of a moderate degree associated with a moderate cystocoele in a postmenopausal patient should prompt the consideration of vaginal hysterectomy to prevent recurrent pro-
The four-corner procedure is a simple surgical alternative to correct a moderate cystocele with or without prolapse symptoms. This procedure is also efficacious in treating SUI associated with a moderate cystocele.

REFERENCES