One-year outcomes of a suture-less laparoscopic sacral hysteropexy using polypropylene Y-mesh grafts and fibrin sealant spray: A prospective comparative study

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ABSTRACT

Background: Laparoscopic sacral hysteropexy (SH) is a minimally invasive and effective treatment for uterovaginal prolapse in women who wish to retain the uterus. However, this procedure is limited by a steep learning curve and a long operating time. In this study, we aim to evaluate the surgical outcomes of a modified laparoscopic SH procedure using innovative methods of vaginal mesh attachment, which we hypothesized to be equally effective and time-saving.

Methods: This was a prospective, parallel, comparative study conducted at a tertiary referral hospital. A total of 34 women with advanced (POPQ [Pelvic Organ Prolapse Quantification] stages ≧ 2) uterine prolapse, who underwent a laparoscopic SH procedure using lightweight polypropylene Y-mesh grafts (ALYTE), were studied. In half (n = 17) of the cases, fibrin sealant spray (TISSEEL) was applied to the meshes fixed at the anterior and posterior vaginal wall with fewer (six vs at least ten) sutures. A detailed comparison of one-year outcomes between groups was performed.

Results: Patient characteristics and perioperative results were comparable between groups with the exception of a significantly shorter total operating time (247.0 vs 292.9 minutes, $p = 0.04$) noted in the fibrin group. At 1 year, anatomic success (POPQ stage ≦1) rates (76.5% vs 76.5%) were not different between groups. There were eight patients, with four in each group, who had surgical failure. Notably, most (7/8; 87.5%) surgical failures were at the anterior compartment (i.e, recurrent cystocele). No vaginal mesh extrusions were noted. After statistical analysis, we found "cystocele as the dominant prolapse before operation" was a significant predisposing factor for prolapse recurrence ($p = 0.019$; odds ratio = 8.04).

Conclusion: The modified laparoscopic SH procedure using Y-mesh grafts and fibrin sealant spray with fewer vaginal sutures was equally effective as conventional methods but saved time. Laparoscopic SH using Y-mesh grafts might not be as effective in repairing a concomitant dominant cystocele.

Keywords: Fibrin sealant; Lightweight polypropylene meshes; Sacral hysteropexy; Uterine preservation; Uterovaginal prolapse.

1. INTRODUCTION

Laparoscopic sacral hysteropexy (SH), first investigated by Price et al.,[1] is a laparoscopic variation of the open method involving suspension of the uterus from the sacral promontory using bifurcated polypropylene meshes.[2] Medium-term anatomical and functional results are not statistically different between open and laparoscopic approaches. However, laparoscopy allows for a significant reduction in blood loss, complications, hospital stay, and a more rapid return to normal activity.[3] Compared with hysterectomy plus sacral colpopexy (SC), SH reduces rates of mesh extrusion, operating time, blood loss, and surgical cost without differences in prolapse recurrence.[4] A recent systematic review suggested laparoscopic SH is a feasible alternative for women who need surgical correction of uterovaginal prolapse and desire preservation of the uterus.[5]

Despite the many advantages, many surgeons are still reluctant to attempt laparoscopic SH because of a steep learning curve that involves performing complicated surgical steps and a long operating time. The establishment of a learning curve in laparoscopic SC has been extensively studied.[6–9] Claerhout et al. found that a single experienced surgeon has to perform 60 laparoscopic SC to overcome the learning curve. Operating time declined rapidly during the first 30 procedures and reached a steady state after 90 surgeries with unchanged complication rates.[6] These studies also indicated that rate-limiting steps of laparoscopic SC are the determination of correct planes for safe dissection and the high number of sutures.[7–9] Theoretically, a reduction in the number of sutures would save time during surgery; however, there is little evidence to demonstrate that the minimum amount of sutures required to secure mesh to the

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vagina in a laparoscopic SC and/or SH saves time. The study results by Schaub et al.[10] suggested six interrupted vaginal sutures might be enough for the fixation of a Y-shaped mesh; however, no control study was done. For better mesh attachment, most studies use 4–6 stitches in both anterior and posterior compartment.[7,11,30,32] On the other hand, several investigators suggested that using continuous instead of interrupted sutures was effective in shortening the operating time in randomized control studies.[11,12]

Recently, there has been clinical evidence that supports the application of fibrin tissue adhesive as a means of mesh fixation in the repair of inguinal and incisional hernias.[13–15] These procedures have shown an association with shorter operating times, hospital stays, and lower rates of recurrence and chronic pain than conventional suture methods. Accordingly, we hypothesized that using fibrin tissue adhesive in a laparoscopic SH procedure for vaginal mesh attachment with fewer sutures might result in comparable outcomes to conventional methods but is a time-saving technique.

In this study, we aimed to enroll a homogeneous group of patients with advanced stages of uterine prolapse who wished to retain the uterus. We evaluated the 1-year follow-up results of a modified laparoscopic SH procedure with innovative methods of vaginal mesh attachment using fibrin tissue adhesive with fewer sutures compared with those performed using conventional methods.

2. METHODS

2.1. Study protocol

This was a prospective, parallel, comparative study conducted at a tertiary referral hospital. Between January 2016 and December 2017, 34 women scheduled to undergo a laparoscopic SH were enrolled consecutively. The inclusion and exclusion criteria were described in our previous study.[16] In brief, inclusion criteria were presentation with a symptomatic uterine prolapse ≧ POP-Q stage 2 (i.e., C point ≧ –1) in patients who wished to retain the uterus, no known uterine or cervical pathology, no previous prolapse mesh repair, no diseases known to affect bladder or bowel function, etc. Patients were counseled to undergo a laparoscopic SH procedure using a lightweight (20 gm/m^2) polypropylene Y-mesh graft (ALYTE, C.R. Bard, Covington, GA). They could choose to receive a self-paid fibrin sealant spray (TISSEEL, Baxter AG, Vienna, Austria) for vaginal mesh attachment with fewer sutures (six vs at least 10 stitches) during operation according to their personal preference and insurance status. All patients gave informed consent for the operation and the follow-up studies after thorough counseling. The primary outcome measures were anatomic (objective) success rates and functional results. The secondary outcome measures were surgical complications and reoperations. Approval for this clinical trial was obtained from the Ethics Committee at our institution (CMUH106-REC1-122).

2.2. Baseline assessment

Before operation, all patients underwent a thorough investigation including a pelvic examination, a multi-channel urodynamic study with prolapse reduction, and questionnaires using the short-form Pelvic Floor Distress Inventory (PFDI-20) and Pelvic Floor Impact Questionnaire (PFIQ-7).[17] Prolapse was quantified according to the Pelvic Organ Prolapse Quantification (POPQ) system.[18] The urodynamic study was performed according to the standards proposed by the International Urogynecological Association and the International Continence Society.[19]

2.3. Surgical intervention

Operations were performed according to the surgical technique described in a previous study conducted by Price et al.[1] The surgical team (M.-J.H. and C.-P.T.) was skilled in laparoscopic and vaginal reconstructive surgeries. The key steps of our procedures are shown in Figure 1. Before operation, the anterior strip of the Y-mesh graft was cut into two arms at the midline. The operation started by creating two windows in the broad ligaments to allow the arms of the anterior strip of the Y-mesh graft to be brought through the openings from the posterior to the anterior. Subsequently, the mesh arms were sutured to the anterior lip of uterine cervix with interrupted non-absorbable sutures (No. 2-O Ethibond). The suture technique was standardized in this study(tied intracorporeally with a sufficient 6-7 knots). The base portion of the posterior mesh was then sutured to the posterior utero-cervical junction. The anterior mesh extended distally to the level of urethro-vesical junction and the posterior mesh to the perineum body through rectovaginal space. In half (17/34) the cases, fibrin sealant spray was applied to the meshes fixed on the anterior and posterior vaginal wall with reduced suturing (six stitches vs 10 stitches at least) (Fig. 2). The fixation sites of the six stitches were similar to that described by Schaub et al.[10] The sacral fixation of the tail of the Y-mesh graft was performed using two interrupted non-absorbable sutures (No. 2-O Ethibond). The surgery was completed after re-peritonization. Concomitant surgeries were performed as indicated, i.e., a mid-urethral sling procedure (TVT-O, Ethicon, Somerville, NJ) for urodynamic stress incontinence, a perineorrhaphy for perineal defect, and a vaginal trachelectomy for elongated uterine cervix. Postoperatively, all patients underwent transurethral bladder drainage. A voiding trial began on postoperative day 3. The Foley catheter was removed once the patient could void freely with the post-void residuals of <25% of the total bladder volume and was <100 ml on two occasions.

2.4. Follow-up investigation

Postoperative follow-up examinations were performed at 6 weeks, 3, 6 and 12 months, and then annually. Follow-up assessment and data collection were performed by a clinical research fellow (C.-K.L.) who was blinded to patient baseline data to eliminate bias. The effectiveness of surgery was considered successful in patients who were free of bulge or pressure symptoms and in whom the vaginal support was POPQ stage ≦1. Functional outcome was measured by comparing the pre- and postoperative scorings on the PFDI-20 and PFIQ-7, respectively. During each postoperative follow-up, a thorough pelvic examination was performed which included measuring POPQ parameters, finding evidence of vaginal mesh extrusion, and a cough stress test.

2.5. Statistical analysis

Clinical data are presented as mean ± SD, median (range) or percentage when appropriate. Univariate analysis was used to compare the demographic and various parameters between groups. The association between anatomic (objective) outcomes and 12 important clinical variables (i.e., age, body mass index; preoperative Ba, C, Bp values; anterior, middle, posterior and total POPQ stages; dominant prolapse sites, concomitant mid-urethral sling, with or without fibrin sealant spray) was assessed by a multivariate logistic regression analysis. A p-value of <0.05 was considered statistically significant. Statistical analyses were performed using SAS 9.2 software (SAS Institute Inc, Cary, NC).

3. RESULTS

3.1. Patient characteristics

In the 34 patients enrolled, half of the laparoscopic SHC procedures were done using fibrin sealant spray (TISSEEL) for vaginal mesh attachment (Fibrin group, n = 17). For the remaining

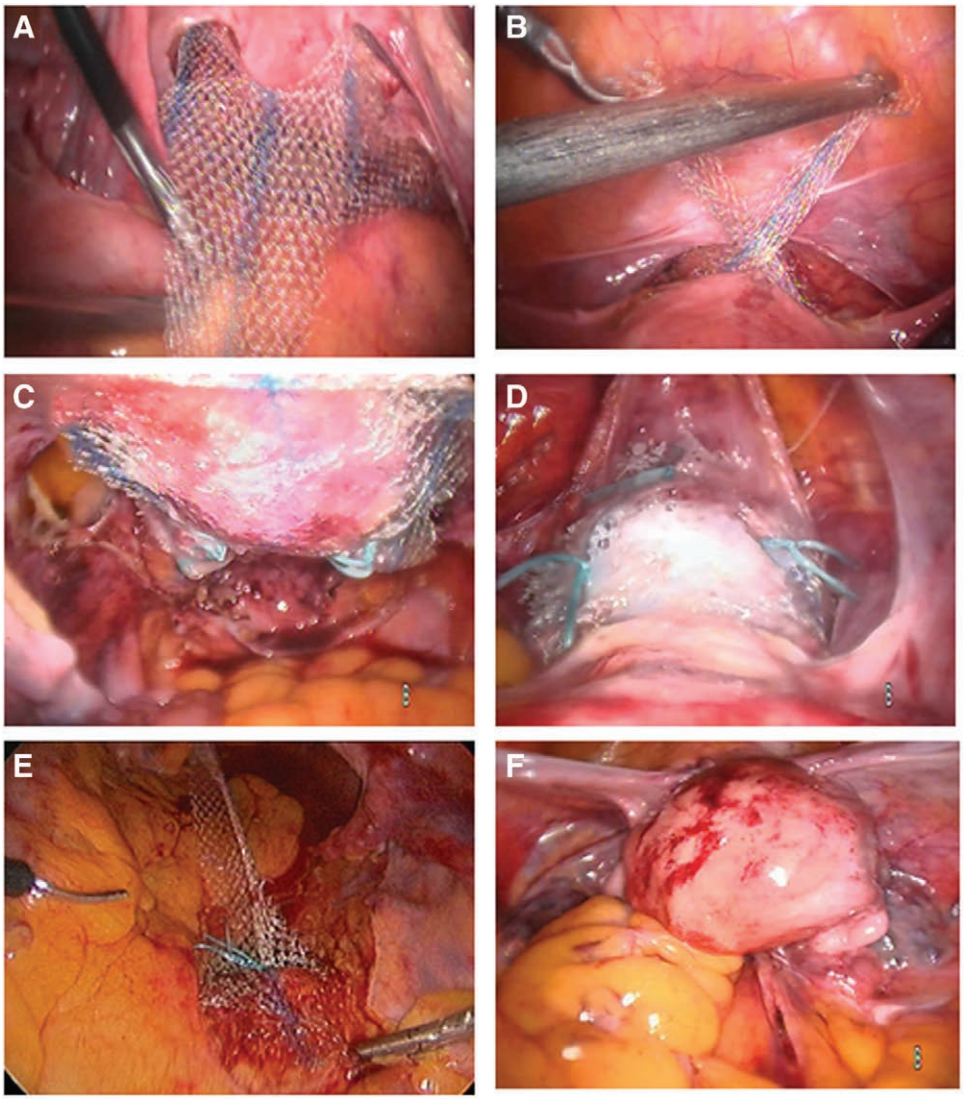

Fig. 1. The surgical steps of a modified laparoscopic SH procedure using lightweight polypropylene Y-mesh grafts and fibrin sealant spread with fewer vaginal sutures: (A) passage of Y-mesh after creating windows in the broad ligament; (B) anterior lips of Y-mesh inserted through the broad ligament; (C) fixation of Y-mesh posteriorly with three sutures and fibrin sealant spray; (D) fixation of Y-mesh anteriorly with three sutures and fibrin sealant spray; (E) promontory fixation of the tail of Y-mesh with two sutures; (F) mesh in situ and re-peritonization completed. SH = sacral hysteropexy.

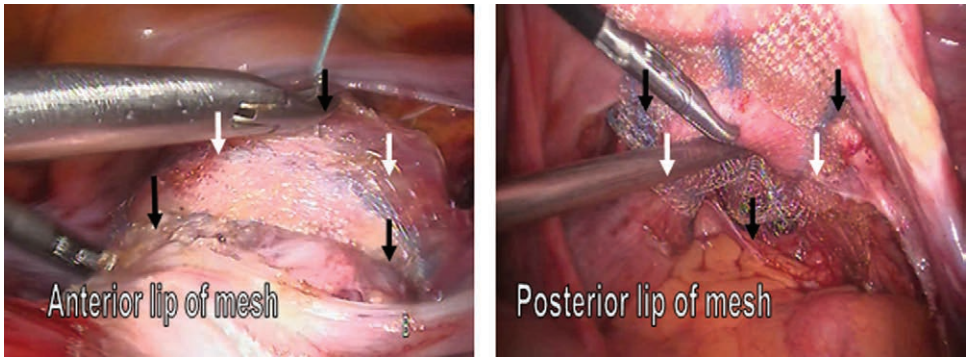

Fig. 2. Sites of vaginal mesh suture fixation. (In surgeries with fibrin sealant spray, sutures indicated by white arrows could be omitted.)

procedures, only non-absorbable sutures (No.2-O Ethibond) were used for vaginal mesh fixation (Suture group, n = 17). Preoperative characteristics of patients are shown in Table 1. Demographic data and preoperative urodynamic diagnoses were not significantly different between groups.

3.2. Surgical results

Surgical data are summarized in Table 2. The perioperative data, percentage of concomitant surgeries, rates of surgical effectiveness, and complications were not significantly different between groups. However, compared with the Suture group, the Fibrin group was characterized by a significantly shorter total operating time (247.0 vs 292.9 minutes, p = 0.04) with each case being shorter by an average of 45 minutes (15.6%). Notably, no vaginal mesh extrusion was noted in this study.

Anatomic outcomes, assessed by comparing the pre- and postoperative POPQ stages are shown in detail in Table 3. Anatomic (objective) success rates (POP stage 0 or 1) were the same with a rate of 76.5% (13/17) in each group. There was a statistically significant improvement in all POPQ stages of the three vaginal compartments after both procedures. At the one-year follow-up, there were a total of eight surgical failures with four cases in each group. Most (7/8) cases of surgical failure occurred in the anterior compartment (i.e., recurrent cystocele) and one case in the suture group had recurrent stage 2 rectocele. No patients experienced recurrent uterine prolapse.

Functional outcomes, assessed by comparing the preoperative and postoperative PFDI-20 and POPIQ 7 scores are also shown in Table 3. Statistically significant improvements were noted in various pelvic symptoms and the quality of life index in both groups and there was no significant difference between groups.

3.3. Outcome associations

Table 4 shows the results of a comparison of 12 important clinical variables between anatomic (objective) outcome groups by univariate analysis. Further multivariate logistical regression analysis suggested that anatomic (objective) failure (POP stage ≧2) after the laparoscopic SH procedures was significantly associated with "cystocele as the dominant prolapse before operation (i.e., Ba > C, Bp)" (p = 0.019; odds ratio = 8.04).

4. DISCUSSION

To the best of our knowledge, this is the first study to apply fibrin tissue adhesive for mesh attachment in prolapse repair. The modified laparoscopic SH procedure was characterized by suspension of a prolapsed (≧ POPQ stage 2) uterus using lightweight polypropylene Y-mesh grafts (ALYTE) and the application of fibrin sealant spray (TISSEEL) for vaginal mesh attachment with a reduced number of sutures. One-year follow-up results suggested the modified procedure was equally effective as conventional methods but was also time-saving.

Since the warning about the use of vaginal mesh by the US Food and Drug Administration in 2008 and 2011, there has been increased utilization of minimally invasive SC and decreased use of mesh-augmented vaginal suspensions over time.[20–22] SC is better than a variety of vaginal interventions including vaginal meshes in apical prolapse repair with lower rates of prolapse recurrence, reoperations, postoperative stress incontinence, and dyspareunia.[23–25] Although the performance of SC has increased as a whole, it is still a small proportion of the total cases. Most apical prolapse repairs are still performed via vaginal approaches.[20–22] Minimally invasive SC/SH is limited by a steep learning curve and a long operating time that involves performing complicated surgical steps and using a high number of sutures.[6–9] To shorten the operating time associated with laparoscopic SC/SH, methods such as reducing the number of sutures and using continuous rather than interrupted sutures have been suggested by investigators.[10–12]

In this study, fibrin sealant spray was used for vaginal mesh attachment in a modified laparoscopic SH procedure using fewer vaginal sutures. The use of fibrin tissue adhesive for mesh attachment is not a novel concept, but its application has been limited thus far to hernia repair. The advantages were the shortened operating times, hospital stays, and lower rates of recurrence and chronic pain compared with conventional methods.[13–15] In this study, the perioperative results (Table 2) were similar between groups with the exception of a significantly shorter total operating time (247.0 vs 292.9 minutes, p = 0.04) noted in the group using fibrin sealant spray with each case being shorter by an average of 45 minutes (15.6%). In contrast to other studies previously reported,[1,10] our average operation time was longer, even in the Fibrin sealant group. This longer operation time is due to: (1) our reported total operating time included both laparoscope preparation time

Table 1.

Preoperative characteristics of patients (n = 34) who underwent laparoscopic SH using lightweight polypropylene Y-mesh grafts, with or without fibrin sealant spray

	Fibrin group (n = 17)		Suture group (n = 17)		
Patient characteristics	**Value**	**Range**	**Value**	**Range**	***p***
General data					
Mean age (year)	51.7 ± 10.3	33 – 67	53.7 ± 7.3	43 – 64	0.786[a]
Median parity	2	0 – 4	2	1 – 3	0.734[a]
Mean body mass index (kg/m^2)	23.7 ± 3.3	17.4 – 28.6	24.8 ± 2.2	20.8 – 29.9	0.322[a]
% Menopause	58.8	10/17	70.6	12/17	0.721[b]
% Diabetes mellitus	11.8	2/17	17.6	3/17	1.000[b]
Urodynamic diagnoses					
% Bladder hypersensitivity	47.1	8/17	29.4	5/17	0.728[b]
% Detrusor over-activity	11.8	2/17	11.8	2/17	1.000[b]
% Urodynamic stress incontinence	47.1	8/17	35.3	6/17	0.728[b]
% Bladder outlet obstruction	41.2	7/17	35.3	6/17	1.000[b]
% Detrusor underactivity	17.6	3/17	0	0/17	0.227[b]

[a] Mann-Whitney tes.
[b] Fisher's exact test.
SH = sacral hysteropexy.

Table 2.

Surgical data of patients (n = 34) who underwent laparoscopic SH using lightweight polypropylene Y-mesh grafts, with or without fibrin sealant spray

Parameters	Fibrin group (n = 17) Value	Fibrin group (n = 17) Range	Suture group (n = 17) Value	Suture group (n = 17) Range	*p*
Perioperative data					
Mean hospital stay (days)	4.4 ± 0.7	3 – 5	4.7 ± 0.8	4 – 7	0.413[a]
Mean Foley drainage (days)	3	3	3.4 ± 1.3	3 – 8	0.563[a]
Mean total operating time (minutes)	247.1 ± 27.1	210 – 300	292.9 ± 50.3	120 – 290	0.004[a]
Mean estimated blood loss (ml)	118.8 ± 77.2	50 – 350	132.4 ± 82.8	50 – 400	0.339[a]
Mean pain VAS postop. Day 1	2.7 ± 0.6	2 – 4	3.1 ± 0.6	2 – 4	0.140[a]
Concomitant surgeries					
% Mid-urethral sling	47.1	8/17	35.3	6/17	0.728[b]
% Vaginal trachelectomy	23.5	4/17	17.6	3/17	1.000[b]
% Perineorrhaphy	58.9	10/17	82.4	14/17	0.146[b]
Surgical effectiveness					
% Pelvic organ prolapse (≦ stage 1)	76.5	13/17	76.5	13/17	1.000[b]
% Stress urinary incontinence (cure)	100	8/8	100	6/6	1.000[b]
Surgical complications					
% Pelvic hematoma	0	0/17	0	0/17	1.000[b]
% Pelvic inflammatory disease	5.9	1/17	0	0/17	1.000[b]
% Delayed free voiding (>7 days)	0	0/17	5.9	1/17	1.000[b]
% De novo stress incontinence	0	0/9	18.2	2/11	0.485[b]
% De novo urgency incontinence	0	0/17	11.2	2/17	0.485[b]
% Vaginal mesh extrusion	0	0/17	0	0/17	1.000[b]

[a] Mann-Whitney test

[b] Fisher's exact test.

SH = sacral hysteropexy.

Table 3.

Anatomic and functional outcomes in patients (n = 34) who underwent laparoscopic SH using lightweight polypropylene Y-mesh grafts, with or without fibrin sealant spray at one-year follow-up

	Fibrin group (n = 17)					Suture group (n = 17)					
	Pre-op		Post-op		*p**	Pre-op		Post-op		*p**	*p*** post-op groups
Anatomic outcome (POPQ stages)											
Anterior site		%		%	<0.001		%		%	<0.001	1.000
Stage 0-I	6	35.3	13	76.5		2	11.8	14	82.4		
Stage II	5	29.4	4	23.5		5	29.4	3	17.6		
Stage III	4	23.5	0	0		7	41.2	0	0		
Stage IV	2	11.8	0	0		3	17.6	0	0		
Apical site					<0.001					<0.001	1.000
Stage 0–I	0	0	17	100		0	0	17	100		
Stage II	8	47.1	0	0		6	35.3	0	0		
Stage III	5	29.4	0	0		6	35.3	0	0		
Stage IV	4	23.5	0	0		5	29.4	0	0		
Posterior site					<0.001					<0.001	1.000
Stage 0–I	5	29.4	17	100		5	29.4	16	94.1		
Stage II	8	47.1	0	0		5	29.4	1	5.9		
Stage III	1	5.9	0	0		4	23.5	0	0		
Stage IV	3	17.6	0	0		3	17.6	0	0		
Functional outcome											
PFDI-20	18.8 ± 16.3		2.4 ± 2.8		0.009	14.9 ±10.8		5.1 ± 4.8		0.004	0.153[a]
POPIQ-7	7.0 ± 5.2		0 ± 0		0.006	7.4 ± 5.6		1.3 ± 2.8		0.005	0.411[a]

* Wilcoxon test.

** Fisher's exact test.

[a] Mann-Whitney test.

PFDI = Pelvic Floor Distress Inventory; SH = sacral hysteropexy.

and concomitant surgeries, (2) performing both anterior and posterior mesh fixation with multiple sutures, and (3) the use of 2-3 sutures for fixation of the mesh onto the promontory, rather than the tacker.

At one year, the anatomic and functional outcomes were also comparable between groups (Tables 2 and 3). Besides, there was no significant difference between groups regarding the rates of surgical complications, and there were no reoperations.

Table 4.

Comparison of important clinical variables between anatomic (objective) outcome groups after a laparoscopic SH procedure using lightweight polypropylene Y-mesh grafts, with or without fibrin sealant spray.

	Cure (n = 26)		Failure (n = 8)		
	Value	Rage	Value	Range	*p*
Patient characteristics					
Mean age (year)	51.2 ± 9.1	33 – 65	57.5 ± 5.7	49 – 67	0.067[a]
Mean body mass index (kg/m^2)	24.1 ± 2.7	17.4 – 28.6	24.9 ± 3.1	21.0 – 29.9	0.715[a]
Pre-op POPQ parameters					
Ba (cm)	1.2 ± 3.1	–2 to +6	3.6 ± 2.6	–1 to +7	0.071[a]
C (cm)	2.6 ± 3.0	–1 to +8	2.9 ± 4.1	–3 to +9	0.919[a]
Bp (cm)	0.7 ± 3.0	–2 to +6	1.3 ± 3.2	–2 to +7	0.535[a]
POPQ stage	2.9 ± 0.8	2 – 4	3.3 ± 0.7	2 – 4	0.232[b]
POPQ-A	2.2 ± 1.1	1 – 4	2.9 ± 0.6	2 – 4	0.100[b]
POPQ-M	2.8 ± 0.8	2 – 4	2.8 ± 1.2	1 – 4	0.949[b]
POPQ-P	2.2 ± 1.0	1 – 4	2.4 ± 1.1	1 – 4	0.640[b]
Dominant prolapse					
Cystocele (Ba > C, Bp)	15.4%	4/26	50%	4/8	0.047[b]
Vaginal mesh attachment					
Fibrin sealant spray	50%	13/26	50%	4/8	1.000[b]
Sutures	50%	13/26	50%	4/8	1.000[b]
Concomitant surgeries					
% Middle urethral sling	34.6%	9/26	75%	6/8	0.100[b]

[a] Mann-Whitney test.

[b] Fisher's exact test.

POPQ = Pelvic Organ Prolapse Quantification; SH = sacral hysteropexy.

Conclusively, the shortened total operating time, coupled with favorable clinical results, suggests that our modified laparoscopic SH procedure is a feasible alternative with comparable effectiveness to conventional methods and saves time.

Patients enrolled in this study were those who were referred for counseling on uterine preservation surgeries for advanced stages (POPQ stage ≧ 2) of uterine prolapse at the patient's request. We offered these patients a laparoscopic SH procedure based on recent evidence that support its minimal invasiveness, safety, effectiveness, and its advantages over a variety of vaginal interventions including vaginal mesh suspension.[3–5,23–26] The mean age of the 34 women was 52.7 (33–67) years and most (22 of 34; 64.7%) were postmenopausal (Table 1). The reasons for requesting uterine preservation were not evaluated in this patient population; however, fertility desires should not be the major concern. The study results by Korbly et al.[27] suggested geographic region, education level, and belief that the uterus is important for a sense of self were predictors of preference for uterine preservation. Recently, there is a trend toward operations for uterine preservation worldwide.[20–22] Furthermore, women who were referred with prolapse complaints were noted to have a preference for uterine preservation compared with hysterectomy assuming surgical outcomes were equal.[27,28] Based on these findings, surgeons should be prepared to offer uterine preservation as an option to appropriate women who desire this choice during apical prolapse repair.

In this study, we demonstrated that laparoscopic SH procedures were an effective approach for middle compartment repair, with no patients experiencing apical prolapse recurrences (Table 3). However, a rate of 20.6% (7/34) of anterior compartment descent, although mostly asymptomatic, requires attention. The disadvantages of laparoscopic SH for anterior vaginal repair have been noted with a rate of 14.7%–25.0% of recurrent cystocele after operations.[29–31] Costantini et al.[31] suggested that preparation of the anterior vaginal wall is made more difficult by the presence of the uterus, which may explain at least in part the higher recurrence of cystocele compared with typical rates in patients without a uterus. In this study, a multivariate logistical regression analysis was conducted which showed that "a dominant cystocele (i.e., Ba > C, Bp) before operation" was a significant predisposing factor for the recurrence at the same site (Table 4). Since the anterior vaginal prolapse was repaired by simply anchoring the anterior strip of a Y-mesh graft along the vaginal length, the recurrence most likely resulted from the lateral defects of a cystocele that was not repaired by this technique.[32] Some surgeons perform additional retro-pubic paravaginal repair or colpo-suspension with minimally invasive SC/SH procedures in patients with severe cystocele.[33,34] Although this may decrease the recurrence at the anterior site, it may not improve the overall success rate of prolapse repair because of the predisposition to a recurrence in the posterior compartment.[34] Fortunately, in this study none of the patients required reoperation for prolapse recurrence. Our results suggest that most of the recurrent cystoceles after laparoscopic SH using Y-mesh grafts were not problematic because of the intra-vaginal position and the lack of symptoms. However, a longer-term follow-up observation is needed.

No serious complications were noted in this study (Table 3). De novo stress incontinence was the most prevalent (2/20; 10%) complication in this study after laparoscopic SH procedures. The study conducted by Leruth et al. reported that 54.5 % and 23.6% of 55 patients, who had negative preoperative prolapse reduction stress testing, developed stress incontinence after a laparoscopic SC procedure by symptoms or by examination. After statistical analysis, a history of stress incontinence preoperatively was found to be the sole independent predictor of de novo stress incontinence after the operation.[35] Our rates (10%) were lower, which may be attributed to our strategy of managing stress incontinence concomitantly in a prolapse repair. An additional mid-urethral sling was performed in 41.2% (14/34) of our patients for overt or occult stress incontinence after a thorough urodynamic study and history taking (Tables 1 and 2). An updated Cochrane review also indicated a reduced rate using this strategy.[23] No vaginal mesh extrusion was noted in

this study, which may be due to the lack of an extensive vaginal incision overlying the vaginal mesh grafts in the laparoscopic SH procedures.[4,5,23,24]

The limitations of this study were the relatively small number of cases and patients were not randomly assigned to the two groups and a relatively short follow-up period. Moreover, a comparative cost-effectiveness analysis was not performed as this fell outside the aims of the current study. However, the possibility of a shorter operating time will make the modified laparoscopic SH procedure more economically efficient from the hospital's perspective. The strengths of this study included a homogeneous patient population and the prospective control study. In addition, multivariate logistic regression analyses were performed to account for potential associated factors with surgical outcomes.

In conclusion, our study results suggested that the modified laparoscopic SH procedure using lightweight polypropylene Y-mesh grafts and fibrin sealant spray with fewer vaginal sutures was safe, effective, and time-saving. A prospective randomized controlled trial with a larger patient sample and a longer follow-up period is needed to confirm these results.

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