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ORIGINAL ARTICLE

Modified McCall culdoplasty versus Shull suspension in pelvic prolapse primary repair: a retrospective study

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Abstract
Introduction and hypothesis Uterosacral ligament suspension at the time of primary prolapse repair represents a well-established surgical option. Our aim was to compare the effectiveness, complications rate, and functional results of modified McCall culdoplasty and Shull suspension.
Methods Patients who underwent vaginal hysterectomy and cuff suspension for pelvic organ prolapse were retrospectively analyzed. McCall culdoplasty (group A) or Shull suspension (group B) were performed according to surgeon choice based on age and sexual activity. Perioperative data, objective, and subjective cure rate were noted.
Results A total of 339 patients (215 in group A and 124 in group B) completed follow-up. Operating time and blood loss were slightly higher in group B. The complications rate was similar in the two groups. Anatomical outcomes in terms of recurrence and reoperation rate did not show any statistically significant differences. POP-Q items analysis revealed only a different total vaginal length between groups (8 mm longer in group B). Functional outcomes were similar in the two groups as was patient satisfaction.
Conclusion Both uterosacral ligament suspension procedures were shown to be safe and effective. There were no clinically significant differences with regard to surgical data, complications, anatomical, functional, and subjective outcomes between modified McCall culdoplasty and Shull suspension.

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Keywords Uterosacral ligament suspension · McCall culdoplasty · Shull suspension · Pelvic organ prolapse · Quality of life

Introduction

Pelvic organ prolapse (POP) is defined as the descent of the vaginal walls, uterus or cuff [1]. It is a common clinical condition affecting 50 % of parous women over 50 years of age [2]. The estimated lifetime risk of POP surgery and the re-operation rate ranges are 6.3 to 11 % and 13 to 30 %, whereas recurrence appears to be associated with pre-operative advanced genital prolapse, obesity, chronic cough, constipation, and macrosomia [3–5]. However, the natural history of recurrence is still unclear and an inappropriate reconstructive surgical procedure could negatively affect the outcomes [6]. It is well established that restoring vaginal apical support is the cornerstone of primary surgical treatment [7] and several surgical techniques have been described to support the vaginal cuff via both the vaginal and the abdominal route [8]. In the last few decades, procedures involving the use of synthetic grafts have been introduced [9]. Owing to recent Food and Drug Administration advisory committee concerns about mesh, there has been renewed interest in native tissue repair that can involve endopelvic fascia structures (i.e., uterosacral ligament), pelvic diaphragm (i.e., the iliococcygeus muscle or puborectalis muscle) or ligamentous structures (i.e., the sacrospinous ligament; http://www.fda.gov/downloads/MedicalDevices/Safety/AlertsandNotices/UCM262760.pdf). Endopelvic fascia has been widely studied from a functional point of view: according to DeLancey's theory it plays a pivotal role in the static and dynamic of pelvic visceral support. In normal anatomy, the interaction between level I and level II is responsible for correct vaginal orientation and

physiological visceral function. Conversely, symptoms are the clinical expression of endopelvic fascia damage, which can be either primary or subsequent to a levator ani injury [7]. Thus, surgical treatment should be aimed at repairing fascial impairment, either achieving effective apical support or restoring continuity between level I and level II. Uterosacral ligament suspension at the time of primary fascial repair allows both goals to be achieved, representing a valid surgical option.

In our institution we routinely perform native tissue repair through uterosacral ligaments (USLs) suspension, either by a modified McCall culdoplasty [10] or by Shull suspension [11]. The two techniques use the same supporting structure, but had historically and clinically different purposes. The McCall culdoplasty was developed to obliterate the pouch of Douglas and to prevent enteroceles [12]. In contrast, Shull's technique aimed to provide proper vaginal apical suspension, regardless of obliteration of the pouch of Douglas. Our aim was to compare the effectiveness, complications rate, and functional results of these two techniques.

Materials and methods

The study was approved by the Institutional Review Board of the San Gerardo Hospital in Monza, Italy. Between January 2008 and June 2012, patients who underwent vaginal hysterectomy followed by vaginal suspension to USLs to treat pelvic organ prolapse were retrospectively analyzed. Patients underwent either modified McCall culdoplasty (group A) or Shull suspension (group B) according to the surgeon's choice. Additional surgical procedures, such as anterior or posterior vaginal wall prolapse repair or anti-incontinence procedures, were performed when indicated. Preoperative evaluation included medical interview and clinical examination. The presence of urinary, sexual, and bowel disorders was assessed. Lower urinary disorders included outlet obstruction, stress, and urge incontinence. The severity of urinary incontinence was evaluated using the International Consultation on Incontinence Questionnaire Short Form (ICIQ-SF) [13]. Bowel complaints included fecal incontinence and constipation, defined as Wexner score >3 [14]. Sexual history was analyzed to investigate the presence of dyspareunia. A complete urogenital examination was performed, evaluating the presence of POP under effort using the Valsalva maneuver. Vaginal prolapse was staged according to the Pelvic Organ Prolapse Quantification system (POP-Q) [15]. All patients underwent preoperative urodynamic evaluation according to ICS standards [16]

Follow-up visits were performed 1, 6, and 12 months after surgery and then annually. Recurrence of anatomical prolapse was defined as any compartment descent ≥ stage II according to the POP-Q system. The severity of urinary incontinence and constipation was evaluated respectively using the ICIQ-SF questionnaire and the Wexner score. The Patient Global Impression of Improvement (PGI-I) score was used to evaluate the patients' satisfaction after surgery [17]. Postoperative urodynamic examination was performed only in cases of worsening or de novo lower urinary tract dysfunction.

Data were entered into the database by one author and double-checked by one other author. Statistical analysis was performed using JMP software version 9.0. Data are reported as mean ± standard deviation. Differences were tested using Student's *t*-test for continuous parametric data, with the Wilcoxon/Kruskal–Wallis test for continuous nonparametric data and with Fisher's test for noncontinuous data. A p value < 0.05 was considered statistically significant.

The two same experienced vaginal surgeons (MR and SF) carried out all surgery. All patients underwent vaginal hysterectomy and salpingectomy according to a standard technique [18]. Bilateral oophorectomy was performed according to menopausal status and patients' will after proper counseling. Preparation of the surgical field is similar for both procedures. USLs and cardinal stump sutures positioned at the time of the hysterectomy are retained as landmarks. Once hysterectomy is completed, a long gauze is placed to pack the small bowel out of the operative field and is lifted by a Breisky–Navratil retractor. An Allis clamp grasping the uterosacral stump close to vaginal rim is bilaterally placed and gentle traction is applied to better expose and palpate the USL path on both sides. When technically feasible, the position of the ureter is identified.

Modified McCall suspension

Midline uterosacral plication is performed with two consecutive polydioxanone monofilament long-term absorbable 0 sutures (Assufil monofilamento™, Assut Europe, Rome, Italy). The first suture is passed through both USLs at the level of the ischial spines, a plane that mostly corresponds to the middle third of the ligament. Once tightened, the suture is pulled caudally to expose the upper portion of the ligaments. A second suture through both USLs is placed 1 cm cranially to the first one and tightened. These two sutures are referred as "suspending sutures." Pre-rectal peritoneum, apex of the recto-vaginal septum and posterior vaginal wall are transfixed on the midline with both tails of the lowest suspending suture. Bladder peritoneum, vesico-vaginal fascia, and the anterior vaginal wall are transfixed on the midline with both tails of the highest suspending suture [10]. The vaginal cuff is finally sutured on the transversal axis using the USLs and cardinal stump sutures. Conventionally, cardinal stump sutures are placed laterally, whereas USL

stumps sutures are placed halfway between the midline and the vaginal corner.

Shull suspension

On each side, the USL is transfixed with three consecutive polydioxanone monofilament long-term absorbable 0 sutures (Assufil monofilamento™, Assut Europe). Each suture is passed ventral to dorsal to have better control of the suture position and to reduce the risk of ureteral entrapment. The lowest (first) suture is placed at the level of the ischial spine, whereas the two following sutures are placed 1 cm above the previous one. In this way the USL is involved in its middle and upper thirds. In total, six sutures are positioned. These sutures are referred to as "suspending sutures." One end of each suspending suture transfixes the pre-rectal peritoneum, the apex of the recto-vaginal septum and the posterior vaginal wall, whereas the opposite end transfixes the bladder, the peritoneum, the vesico-vaginal fascia, and the anterior vaginal wall. The correct order in which the suspending sutures are passed through the vaginal apex is the lowest at the vaginal corner, the highest close to the midline and the middle one half way between the former two. In this way the anterior vaginal rim is approximated to the posterior vaginal rim on a transverse axis [11].

Vaginal suspension is performed with absorbable sutures in all patients owing to the relatively high apical granuloma rate we had with our previous experience of permanent sutures.

In both procedures, when anterior repair is indicated, suspension sutures that should transfix the vesico-vaginal fascia are passed after its plication. If necessary, posterior repair is performed after suture tightening. At the end of both suspensions a diagnostic cystoscopy is performed to assess ureteral bilateral patency. If urodynamic stress incontinence has been diagnosed, an anti-incontinence procedure is performed as a last surgical step. In our institution we correct stress urinary incontinence with single-incision or retropubic polypropylene slings.

Results

A total of 351 women underwent vaginal hysterectomy and USL suspension in the study period: 225 underwent modified McCall culdoplasty (group A) and 126 Shull suspension (group B). Except for age and menopausal status, patient characteristics were comparable in the two groups (Table 1). The preoperative vaginal profile according to the POP-Q system and baseline symptoms (urinary incontinence, voiding dysfunction, constipation, and dyspareunia in sexually active patients) were the same in the two groups. Enterocele ≥ stage 1 was present in 23 (10.2 %) and 13 patients (10.3 %) respectively. The preoperative prevalence of sexual activity was significantly higher in group B (Table 2).

The intraoperative additional procedures rate for prolapse repair, such as anterior or posterior repair and suburethral slings, was similar in the two groups. Operative data showed a slightly longer operating time and greater blood loss in group B. The overall major complications rate did not show any differences between the groups (Table 3). Ureteral kinking was identified intraoperatively using cystoscopy and IV indigo carmine. It was treated with ureteral stenting when possible, otherwise with intraoperative revision of the sutures. Hemoperitoneum was treated conservatively with red blood cell concentrate transfusion in 2 cases out of 3. One case of vault abscess was treated with laparoscopic surgical toilette and i.v. antibiotics. One case of bladder perforation required cystorrhaphy and a Foley catheter for 2 weeks. Postoperative transient outlet obstruction was managed with intermittent self-catheterization until there was a negative post-voiding residual. However, in one patient who underwent a concomitant anti-incontinence procedure, a prolonged outlet obstruction was treated using a postoperative suburethral sling cut.

A total of 339 patients (215 in group A and 124 in group B) completed a minimum follow-up of 12 months (dropout rate 3.4 % in total: 4.4 % in group A and 1.6 % in group B; $p = 0.22$). Mean follow-up was comparable in the two groups (28.9 ± 16 months in group A and 25.6 ± 14 months in group B). Anatomical outcomes in terms of recurrence of prolapse and reoperation rate did not show any statistically significant difference (Table 4). Pelvic Organ Prolapse quantification outlined a similar outcome in any item with the exception of total vaginal length (TVL), characterized by a longer vagina in group B (Table 4). There was no difference in urinary and bowel function and dyspareunia between the two groups (Table 5). The overall prevalence of sexual activity did not change in the two groups; however, the resumption of sexual activity in formerly sexually inactive patients was significantly higher than the postoperative discontinuation in group B (Fig. 1). Intragroup analysis showed a postoperative improvement in constipation in both groups. The reduction in dyspareunia rates failed to be statistically significant. No differences in urinary symptoms were noted in patients without slings in the intragroup analysis. PGI-I scores were comparable in the two groups (1.35 ± 0.59 in group A and 1.39 ± 0.64 in group B).

Discussion

The surgical strategy for primary prolapse repair varies widely in the literature. It may be performed via the abdominal, laparoscopic or vaginal route, and suspending structures are different from technique to technique. USLs are widely used in pelvic surgery as support for the correction of the apical

Table 1 Patients' characteristics

Demographics	Group A	Group B	*p* value
Age (years), mean (±SD)	66.9 (±9)	56.7 (±9)	<0.001
Menopausal status , *n* (%)	203 (90.2)	91 (72.2)	<0.001
Systemic HRT at the time of surgery, *n* (%)	2 (0.9)	2 (1.6)	ns
Body mass index, mean (±SD)	25.4 (±3.6)	24.5 (±3.5)	ns
Number of vaginal deliveries, mean (±SD)	2 (±1)	2 (±1)	ns
Birth weight of largest baby (g), mean (±SD)	3,647 (±546)	3,660 (±422)	ns
Age at menopause (years), mean (±SD)	50.4 (±3.9)	49.9 (±3.8)	ns

HRT hormone replacement therapy

Table 3 Operative data

	Group A	Group B	*p* value
Multicompartmental repair, *n* (%)	215 (95.6)	119 (94.4)	ns
Suburethral slings, *n* (%)	37 (16.4)	23 (18.5)	ns
Operative time (min), mean (±SD)	106 (±29)	115 (±30)	0.008
Estimated blood loss (ml), mean (±SD)	241 (±158)	297 (±185)	0.003
Total complications, *n* (%)	7 (3.1)	7 (5.6)	ns
Ureteral injuries, *n* (%)	5 (2.2)	3 (2.4)	ns
Visceral injuries, *n* (%)	0 (0)	1 (0.8)	ns
Hemoperitoneum, *n* (%)	1 (0.5)	2 (1.6)	ns
Vaginal cuff abscess, *n* (%)	0 (0)	1 (0.8)	ns
Suburethral sling cut, *n* (%)	1 (0.5)	0 (0.0)	ns

compartment. Many findings support this practice. On a histological basis, the presence of a considerable amount of smooth muscle cells can provide adequate pelvic support [19] and it has been shown that USL is more rigid and less deformable than round and broad pelvic ligaments, making it a suitable anchoring element in prolapse surgery [20]. An anatomical study showed that the intermediate portion of the USL, usually situated above the ischial spine, is the optimal site for fixation, being located in a ureter-free area [21].

In our institution a transvaginal USL suspension is usually performed, either through the modified McCall or Shull technique. We usually prefer to reserve Shull suspension for sexually active and young patients. This is due to the feeling, barely quantifiable, that the cranial third of the vagina is a wider and more habitable shape after Shull suspension compared with the McCall technique. This particular surgical choice reflects the different ages of the populations in the two groups. Operating time and blood loss were slightly higher in Shull's technique, but we consider a mean difference of 9 min and 56 ml of blood as clinically inconsequential with regard to the performance status of the patients.

More relevant were the similar complication rates of the two techniques. In particular, the feared ureteral injuries were very low in both McCall and Shull (1.9 and 0.8 % respectively) and concordant with 1.8 % of ureteral obstruction, which was described in a systematic review of USL suspension [22].

Table 2 Preoperative assessment

	Group A	Group B	*p* value
POP-Q parameter, mean (±SD)			
Aa	+1 (±1.5)	+1 (±1.6)	ns
Ba	+1 (±1.7)	+1 (±1.7)	ns
C	0 (±2.7)	0 (±2.6)	ns
GH	3.6 (±0.5)	3.6 (±0.5)	ns
PB	3 (±0.3)	3 (±0.4)	ns
TVL	10.3 (±1.4)	10.5 (±1.3)	ns
Ap	−1.5 (±1.2)	−1 (±1.3)	ns
Bp	−1.5 (±1.2)	−1 (±1.4)	ns
D	−4.5 (±2.9)	−4.3 (±2.9)	ns
Symptoms , *n* (%)			
Bulging symptoms	215 (95.6)	120 (95.2)	ns
Urge incontinence	42 (19.5)	23 (18.5)	ns
Urinary stress incontinence	78 (36.3)	44 (35.5)	ns
Voiding dysfunction	84 (39.1)	60 (48.4)	ns
Constipation	69 (32.1)	40 (32.3)	ns
Sexual activity	92 (42.8)	90 (72.6)	<0.0001
Dyspareunia[a]	19 (20.7)	22 (24.4)	ns

[a] In preoperatively sexually active patients

Table 4 Anatomical outcomes

	Group A	Group B	*p* value
Recurrences and reoperation rates			
Total recurrence, *n* (%)	45 (20.9)	19 (15.3)	ns
Anterior recurrence, *n* (%)	28 (13.0)	13 (10.5)	ns
Vault recurrence, *n* (%)	3 (1.4)	1 (0.8)	ns
Enterocele, *n* (%)	0 (0)	1 (0.8)	ns
Posterior recurrence, *n* (%)	17 (7.9)	7 (5.6)	ns
Need for reoperation, *n* (%)	3 (1.4)	2 (1.6)	ns
POP-Q parameter, mean (±SD)[a]			
Aa	−2 (±0.9)	−2.1 (±0.8)	ns
Ba	−2 (±0.9)	−2.1 (±0.8)	ns
C	−6.6 (±1.9)	−7 (±1.8)	ns
GH	3.1 (±0.5)	3.1 (±0.6)	ns
PB	3 (±0.3)	3 (±0.3)	ns
TVL	8.4 (±1.5)	9.2 (±1.8)	<0.001
Ap	−2.5 (±0.7)	−2.5 (±0.8)	ns
Bp	−2.5 (±0.7)	−2.5 (±0.8)	ns

[a] Vaginal profiles at the 2-year follow-up visit (145 patients in group A and 73 in group B)

Table 5 Functional outcomes

	Status	Group A	Group B	*p* value
Bulging symptoms		14 (6.2)	10 (7.9)	ns
Urge incontinence	Improved	31 (14.4) [−6]	17 (13.7) [−4]	ns
	Did not vary	11 (5.1) [−1.7]	6 (4.8) [−1.6]	ns
	De novo	25 (11.6) [+2.4]	7 (5.6) [+2.4]	ns
Urinary stress incontinence[a]	Improved	28 (15.7) [−4.3]	14 (13.7) [−3.6]	ns
	Did not vary	20 (11.2) [−1]	12 (11.8) [−0.2]	ns
	De novo	25 (14) [+4.8]	15 (14.7) [+3.8]	ns
Constipation	Improved	35 (16.3) [−5.4]	18 (14.5) [−4.8]	ns
	Did not vary	34 (15.8) [−1.4]	22 (17.7) [−1]	ns
	De novo	15 (7.0) [+4]	14 (11.3) [+4.5]	ns
Dyspareunia[b]	Improved	13 (14.1)	14 (15.6)	ns
	Did not vary	6 (6.6)	8 (8.9)	ns
	De novo	4 (4.3)	5 (5.6)	ns

Mean variations in Wexner (constipation) and ICIQ-SF (urge and stress incontinence) scores in affected patients are listed between square brackets

[a] In patients who did not undergo suburethral sling placement

[b] In preoperatively sexually active patients

Anatomical outcomes were satisfactory with both techniques and recurrence rates were similar at any anatomical site. In particular, both USL suspension techniques were very effective in preventing vaginal vault prolapse. This experience is in accordance with DeLancey's pelvic model, which underlines the crucial role of restoring level I in pelvic support mechanisms. Both techniques in the literature are recognized to be valid procedures for reducing the recurrence of apical prolapse. To our knowledge this is the first work to compare these two techniques. In an RCT study, McCall culdoplasty showed superior results compared with simple peritoneal closure in preventing enterocele after hysterectomy [23]. In prolapse surgery, modified McCall suspension was shown to be effective in primary repair and respectful of the vaginal axis [24]. Modified McCall also proved to be superior to sacrospinous ligament fixation in reducing apical recurrence [10]. In Shull's original paper, the technique was also demonstrated to be very effective and durable in preventing apical recurrence. Furthermore, ureteral injury incidence was as low as 1 % [11]. Interestingly, in most studies and in our

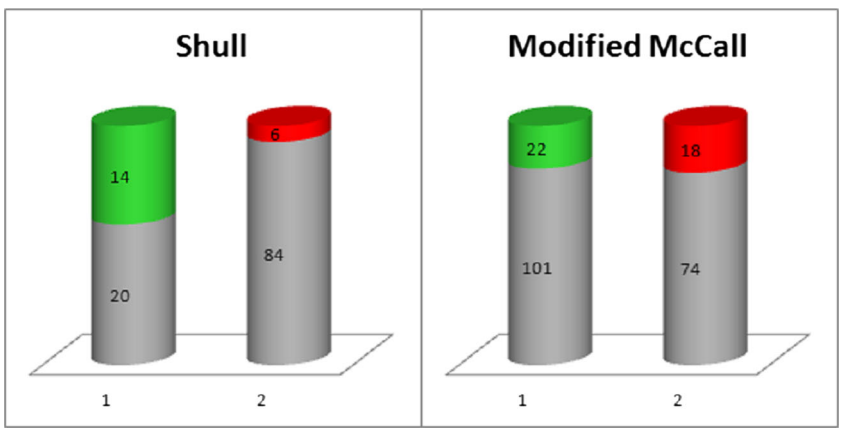

Fig. 1 Changes in sexual activity prevalence in the two groups. *1* preoperatively not active, *2* preoperatively active, *green* increase in activity, *red* cessation of activity

experience, the anterior compartment is the most frequent site of recurrences even after adequate apical repair. This could be a crucial point for native tissue repair, and efforts should be directed at reducing anterior recurrences. However, in our experience the reoperation rate for symptomatic prolapse ranged from 1.4 to 1.6 % with no differences among groups.

Vaginal profiles, expressed with the POP-Q system, were similar in the two groups, with the exception of vaginal length, which is 8 mm longer in group B. This is probably because of the higher placement of the third suture (2 cm above the first one) in the Shull technique compared with the placement of the second suture of the McCall technique (1 cm above the first one). Nevertheless, this difference may be clinically irrelevant if we consider similar outcomes between groups in terms of sexuality. A recent study failed to demonstrate a correlation between vaginal length and quality of sexual life measured using the Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire short form (PISQ-12) score [25]. Functional outcomes were similar in the two groups and were satisfactory overall. These data are in accordance with the review by Margulies et al., which concluded that urinary and bowel symptoms improve after transvaginal USL suspension procedures [22]. Considering sexual function, the same paper showed variable rates in terms of improved and de novo dyspareunia. In our study, dyspareunia relief was reported by 13 out of 19 patients (68.4 %) in group A and by 14 out of 22 patients (63.6 %) in group B, with rates similar to those of other studies [10, 25]. De novo dyspareunia bothered 4.3 % (group A) and 5.6 % (group B) of preoperative sexually active patients, much lower than the 20.8 % described by Silva et al. [26]. The higher rate of resumed intercourse in formerly sexually inactive women in group B could be due to the younger age of these patients; thus, it is difficult to draw any conclusions in this respect. The PGI-I score showed excellent feedback in both groups, ranging between "much improved" and "very much improved."

The strengths of our study include the large number of patients considered, the multimodal objective and subjective evaluation and the adequate follow-up. Limitations are the retrospective study design with nonrandom selection, the lack of a complete panel of quality of life questionnaires, and the differences in age, menopausal status, and sexual activity in the populations. However, we do think that this is still a valid comparison, as preoperative functional disorders and anatomical profiles do not differ in the populations. We aim to carry out a more rigorous prospective, randomized study.

Conclusions

Uterosacral ligament suspension is a safe and effective procedure in the primary treatment of POP. The choice to perform either modified McCall or Shull suspension in relation to the patient's age resulted in a satisfactory outcome. In particular, there are no clinically significant differences in surgical data, complications, and anatomical, functional, and subjective outcomes between the two techniques.

Compliance with ethical standards

Funding None.

Conflicts of interest None.

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