Laparoscopic hysteropexy: the initial results of a uterine suspension procedure for uterovaginal prolapse

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Objective The aim of this study was to evaluate the outcome of laparoscopic hysteropexy, a surgical technique for the management of uterine prolapse, involving suspension of the uterus from the sacral promontory using bifurcated polypropylene mesh.

Design The investigation was designed as a prospective observational study (clinical audit).

Setting The study was undertaken at a tertiary referral urogynaecology unit in the UK.

Population The participants comprised 51 consecutive women with uterovaginal prolapse, who chose laparoscopic hysteropexy as one of the available surgical options.

Methods The hysteropexy was conducted laparoscopically in all cases. A bifurcated polypropylene mesh was used to suspend the uterus from the sacral promontory. The two arms of the mesh were introduced through bilateral windows created in the broad ligaments, and were sutured to the anterior cervix; the mesh was then fixed to the anterior longitudinal ligament over the sacral promontory, to elevate the uterus.

Main outcome measures Cure of the uterine prolapse was evaluated subjectively using the International Consultation on Incontinence Questionnaire for vaginal symptoms (ICIQ-VS), and objectively by vaginal examination using the Baden–Walker halfway system and the pelvic organ prolapse quantification (POP-Q) scale. Operative and postoperative complications were also assessed.

Results The mean age of the 51 women was 52.5 years (range 19–71 years). All were sexually active, and at least three of them expressed a strong desire to have children in the future. All were available for follow-up in clinic at 10 weeks, and 38 have completed the questionnaires. In 50 out of 51 women the procedure was successful, with no objective evidence of uterine prolapse on examination at follow-up; there was one failure. Significant subjective improvements in prolapse symptoms, sexual wellbeing and related quality of life were observed, as detected by substantial reductions in the respective questionnaire scores.

Conclusions Laparoscopic hysteropexy is both a feasible and an effective procedure for correcting uterine prolapse without recourse to hysterectomy. It allows restoration of the length of the vagina without compromising its calibre, and is therefore likely to have a favourable functional outcome.

Keywords Hysteropexy, laparoscopic, mesh, peritonisation, sacrum, uterine prolapse, uterine suspension.
involving suspension of the uterus from the sacral promontory, a uterine-sparing surgical procedure for correction of uterine prolapse, warrants re-evaluation. In this report we describe the surgical technique and initial results of laparoscopic hysteropexy, a uterine-sparing surgical procedure for correction of uterine prolapse, involving suspension of the uterus from the sacral promontory using bifurcated polypropylene mesh.

**Methods**

**Patient selection**

The investigation was designed as a prospective observational study at our tertiary referral urogynaecology unit in Oxford, UK, and is ongoing. Fifty-one consecutive women with symptomatic uterine prolapse, who wished to retain their uterus, and elected for laparoscopic hysteropexy as one of the surgical options, have now been studied over a 3-year period from February 2006 to January 2009. Women with previous abnormal cervical cytological examination, abnormal uterine bleeding, significant uterine enlargement (e.g. uterine fibroids) or concomitant medical problems (e.g. abnormal uterine bleeding, significant uterine enlargement (e.g. uterine fibroids) or concomitant medical problems) were excluded.

**Prolapse assessment**

Prior to surgery, a standardised history and examination of each woman were undertaken in the gynaecology clinic. This included questioning on the presence or absence of prolapse symptoms (vaginal lump, or vaginal pain or discomfort), urinary symptoms (stress incontinence, urgency, frequency, urge incontinence and voiding dysfunction) and bowel symptoms (constipation, urgency, flatus and fecal incontinence, and difficulties with defecation). Objective assessment of pelvic organ prolapse was performed during a Valsalva manoeuvre, in the left lateral position, using a Sims’ speculum. The Baden–Walker halfway system and the pelvic organ prolapse quantification (POP-Q) scale were used to grade the degree of prolapse at all sites. Where indicated, further assessments of pelvic organ function, such as urodynamy studies, were performed. Each woman was then followed up in clinic 2–3 months postoperatively, and was reassessed for pelvic organ prolapse using the Baden–Walker and POP-Q scales. The primary measure for successful objective outcome was the absence of uterine prolapse of grade 1 on the Baden–Walker classification, postoperatively.

Subjective assessment of the prolapse symptoms and their impacts, related sexual matters, and quality of life of these women, were also evaluated both before and 4–6 months after their operations using the validated International Consultation on Incontinence Questionnaire for vaginal symptoms (ICIQ-VS), to measure any change in the condition. The measures for successful subjective outcome were the absence of prolapse symptoms and significant reductions in the respective questionnaire scores for prolapse symptoms, sexual wellbeing and quality of life.

Operative details and perioperative complication data were collected from the clinical case notes.

**Surgical technique**

Surgery was performed by the senior author or under his direct supervision. The procedure was conducted under general anaesthesia with the woman supine and in semi-lithotomy. After skin preparation, draping and catheterisation, a uterine manipulator was inserted. A pneumoperitoneum was created, and four laparoscopic ports were placed: 11-mm umbilical and suprapubic ports and two 5-mm lateral ports. The peritoneum over the sacral promontory was incised with bipolar graspers and monopolar scissors. The ureters were identified bilaterally, and a peritoneal relaxing incision was made medial to the right ureter to retract it away from the operative site.

A bifurcated polypropylene type-1 monofilament macroporous non-absorbable mesh (Atrium Medical Corporation, Hudson, NH, USA) was used to suspend the uterus from the sacral promontory. Each broad ligament at the level of the cervico-uterine junction was opened through the avascular area using diathermy and scissors dissection (Figure 1A, Video S1). The vesico-uterine peritoneum was incised and the bladder dissected distally for 2–3 cm. The arms of the bifurcated mesh were then introduced bilaterally through windows created in the broad ligaments (Figure 1B, Video S1). The arms of the mesh were sutured to the anterior cervix with five or six non-dissolvable non-absorbable polyester 2–0 sutures (Ethibond; Ethicon Inc., Somerville, NJ, USA) (Figure 1C, Video S1). The mesh was then tacked to the sacral promontory using 5-mm helical fasteners (Protack; United States Surgical, Tyco Healthcare, Norwalk, CT, USA) to elevate the uterus. The mesh was placed under moderate tension to achieve adequate elevation of the uterus, aiming to lift the cervix at least 8–10 cm above the level of the introitus.

Our surgical technique for laparoscopic hysteropexy evolved during the study period. Initially, we performed insertion of the mesh laparoscopically, with attachment of the mesh around the cervix and the sacral promontory, without peritonisation of the mesh. However, when performing subsequent laparoscopies on two of our patients who had previously had laparoscopic hysteropexies, we noted some adhesions between the mesh and loops of the bowel.
Afterwards, we amended our technique to include complete peritonisation of the mesh. This was achieved by altering the peritoneal dissection technique. After exposing the longitudinal ligament over the sacral promontory, a peritoneal relaxing incision was made down into the pelvis, laterally to the rectum, but medially to the right ureter. The peritoneum at the level of the insertion of uterosacral ligaments was also mobilised to facilitate the mesh peritonisation. After placement and fixation of the mesh to the cervix, closure of the uterovesical peritoneum was achieved by opposing the peritoneal edges with two or three absorbable polyglactin sutures (Vicryl; Ethicon Inc., Somerville, NJ, USA) (Figure 1D, Video S1). Peritonisation of the mesh at the insertion of uterosacral ligaments was performed prior to fixation of the mesh to the sacral promontory (Figure 1E, Video S1). Complete peritonisation of the mesh was performed after fixation, by opposing the edges of the peritoneum with interrupted absorbable polyglactin sutures (Figure 1F, Video S1).

All women of childbearing age undergoing hysteropexy were advised to be delivered by Caesarean section, if they should subsequently become pregnant, because the mesh could potentially prevent dilation of the cervix during labour.

**Results**

In total, 51 women have now undergone laparoscopic hysteropexy. The mean age of these 51 women was 52.5 years (range 19–71 years), and their mean parity was two deliveries (range 0–5 deliveries). All were sexually active, and at least three of them expressed a desire to have children in the future.

Preoperatively, all women had a significant uterine descent of greater than or equal to grade 2, as measured using the Baden–Walker halfway system. Four women (8%) had a grade-2 uterine prolapse, 40 women (80%) had a grade-3 uterine prolapse, and the remaining seven (13%) had a grade-4 uterine prolapse. In addition, 48 (94%) of the women had a grade-1–3 anterior vaginal wall prolapse, and 50 (98%) had a posterior vaginal wall prolapse with deficient perineal body. Five (10%) of the women had a history of previous anterior or posterior vaginal-wall repair. As well as undergoing laparoscopic hysteropexy, most of the women underwent additional concomitant procedures (Table 1).

Three patients had urinary stress incontinence confirmed by urodynamic studies prior to their prolapse surgery; tension-free vaginal tape was therefore inserted at the time of hysteropexy. Vaginal repairs were performed after laparoscopic hysteropexy, as restoration of apical uterine support often leads to a significant reduction in the prolapse of the vaginal walls, in particular of the anterior vaginal wall. There were no major intraoperative complications. The mean duration of the hysteropexy operations was 50 minutes (range 40–75 minutes), measuring from the first knife
incision, and excluding the time required to perform any concomitant procedures. The mean duration of the postoperative inpatient stay was 2.5 nights.

Two patients developed lower abdominal discomfort, with occasional colicky pain, 4–8 months postoperatively,

Table 1. Concomitant procedures

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Number (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Posterior colpoperineorraphy</td>
<td>36 (71)</td>
</tr>
<tr>
<td>Laparoscopic paravaginal repair</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Anterior colpoperineorraphy</td>
<td>4 (8)</td>
</tr>
<tr>
<td>Tension-free vaginal tape</td>
<td>3 (6)</td>
</tr>
<tr>
<td>Laparoscopic sterilisation</td>
<td>1 (2)</td>
</tr>
<tr>
<td>Mirena coil insertion</td>
<td>2 (4)</td>
</tr>
</tbody>
</table>

Table 2. Objective outcomes of laparoscopic hysteropexy: Baden–Walker grades

<table>
<thead>
<tr>
<th>Baden–Walker grades (n = 51)</th>
<th>Cystocele</th>
<th>Uterine descent</th>
<th>Rectocele</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>Mean 2.1</td>
<td>3.1 1.9</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>2</td>
<td>3 2</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>0 to 4</td>
<td>2 to 4 0 to 3</td>
<td></td>
</tr>
<tr>
<td>Postoperative</td>
<td>Mean 0.4</td>
<td>0.0 0.0</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>0</td>
<td>0 0</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>0 to 3</td>
<td>0 to 2 0 to 2</td>
<td></td>
</tr>
<tr>
<td>Change (postop. – preop.)</td>
<td>Mean −1.7</td>
<td>−3.0 −1.9</td>
<td></td>
</tr>
<tr>
<td>Median</td>
<td>−2</td>
<td>−3 −2</td>
<td></td>
</tr>
<tr>
<td>Range</td>
<td>−3 to 0</td>
<td>−4 to −2 −3 to 0</td>
<td></td>
</tr>
</tbody>
</table>

Table 4. Objective outcomes of laparoscopic hysteropexy: POP-Q measurements

<table>
<thead>
<tr>
<th>POP-Q measurements* (cm) (n = 51)</th>
<th>Aa</th>
<th>Ba</th>
<th>C</th>
<th>D</th>
<th>Ap</th>
<th>Bp</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preoperative</td>
<td>Mean</td>
<td>−1.2</td>
<td>−1.6</td>
<td>−0.3</td>
<td>−1.9</td>
<td>−2.0</td>
</tr>
<tr>
<td>Median</td>
<td>−1</td>
<td>−2</td>
<td>0</td>
<td>−2</td>
<td>−2</td>
<td>−1</td>
</tr>
<tr>
<td>Range</td>
<td>−4 to 0</td>
<td>−5 to 0</td>
<td>−2 to 4</td>
<td>−8 to 2</td>
<td>−6 to 0</td>
<td>−3 to 0</td>
</tr>
<tr>
<td>Postoperative</td>
<td>Mean</td>
<td>−2.5</td>
<td>−5.5</td>
<td>−8.9</td>
<td>−8.4</td>
<td>−6.5</td>
</tr>
<tr>
<td>Median</td>
<td>−3</td>
<td>−6</td>
<td>−9</td>
<td>−9</td>
<td>−6</td>
<td>−3</td>
</tr>
<tr>
<td>Range</td>
<td>−3 to 0</td>
<td>−8 to 0</td>
<td>−10 to −2</td>
<td>−10 to −4</td>
<td>−8 to −4</td>
<td>−3 to −1</td>
</tr>
<tr>
<td>Change (postop. – preop.)</td>
<td>Mean</td>
<td>−1.3</td>
<td>−3.9</td>
<td>−9.1</td>
<td>−6.5</td>
<td>−4.5</td>
</tr>
<tr>
<td>Median</td>
<td>−1</td>
<td>−4</td>
<td>−9</td>
<td>−7</td>
<td>−4</td>
<td>−1</td>
</tr>
<tr>
<td>Range</td>
<td>−4 to 0</td>
<td>−8 to 0</td>
<td>−14 to −5</td>
<td>−11 to −1</td>
<td>−8 to −1</td>
<td>−3 to 0</td>
</tr>
</tbody>
</table>

* Pelvic organ prolapse quantification points, with measurements in cm relative to the position of the general hiatus.
Aa, A point located in the midline of the anterior vaginal wall, 3 cm proximal to the external urethral meatus.
Ba, the most distal/dependent point on the anterior vaginal wall from point Aa to the anterior vaginal fornix or vaginal cuff.
C, the most distal/dependent edge of the cervix or vaginal cuff (a measure of uterine descent).
D, the position of the posterior fornix.
Ap, a point located in the midline of the posterior vaginal wall, 3 cm proximal to the hymen.
Bp, the most distal/dependent point on the posterior vaginal wall above point Ap.
and underwent subsequent laparoscopies. Some adhesions between the sigmoid colon and exposed mesh in one patient, and loops of the small bowel and the mesh in the second patient, were found, and carefully divided, which resolved the pain. Since this observation, our practice has been to peritonise the mesh completely.

All the women were available for follow-up in clinic at 10 weeks, and 39 have now completed the questionnaires 4–6 months after their operations. In 50 out of 51 women (98%) the procedure was successful, with no objective evidence of uterine prolapse on examination at follow-up (Tables 2 and 3). There was one failure. Significant subjective improvements in vaginal (prolapse) symptoms, sexual wellbeing and related quality of life were also observed, as detected by substantial reductions in the respective questionnaire scores (Table 4).

One woman had a persistent grade-2 uterine prolapse that was symptomatic. Repeat laparoscopy was performed, and the mesh further tightened (shortened) by mesh plication with Ethibond sutures. This reduced the uterine prolapse adequately. In addition, five women (10%) had persistent anterior vaginal wall prolapse, and subsequently underwent anterior colporrhaphy under local anaesthesia. There was also one woman with persistent enterocele at follow-up; she is due to have further vaginal enterocele repair.

None of the women underwent subsequent hysterectomy, and none of them has, so far, become pregnant.

Discussion

The concept of uterine preservation during surgery for prolapse is not new. In 1888, Archibald Donald of Manchester, UK, first described the Manchester procedure as an alternative to vaginal hysterectomy for the management of uterovaginal prolapse in patients with cervical elongation and intact uterosacral–cardinal ligaments. The Manchester procedure consists of transvaginal cervical amputation, colporrhaphy and fixation of the cervical stump to the cardinal ligaments. Some have claimed that this procedure has similar cure rates to vaginal hysterectomy for uterovaginal prolapse, with decreased morbidity and mortality. In the early 1900s, Victor Bonney also emphasised the passive role of the uterus in uterovaginal prolapse. Since that time, various authors have reported on their experiences with reconstructive pelvic surgery with uterine preservation.

Several alternative operations for prolapse repair with uterine preservation, using either a vaginal or an abdominal approach, have been proposed. However, most published studies on these are small and retrospective, and their reported success rates vary widely. Open abdominal procedures, including sacrohysteropexy with synthetic Teflon mesh, have been described previously. In a long-term follow-up of this procedure involving 30 patients, recurrence of uterine prolapse was reported in two women. Transvaginal uterosacral plication has been reported to be associated with a high risk of ureteric injury and neurologic morbidity. Sacrospinous hysteropexy has been compared favourably with vaginal hysterectomy and concomitant sacrospinous fixation of the vault in a retrospective series of 70 women with an objective success rate of 74%. Posterior intravaginal slingplasty was first described in 2001, but a high rate of mesh complications, including infection and erosion, has since been reported.

The advancement of laparoscopic equipment and skills has provided the added option of laparoscopic pelvic reconstructive surgery. The advantages of this approach include superior visualisation of the anatomy with laparoscopic magnification, better haemostasis resulting from visualisation and intraperitoneal insufflation pressures, decreased hospital stay, reduced postoperative pain, more rapid recovery and smaller incisions. So far, three types of procedure have been described involving laparoscopic suspension of the uterus: from the round ligaments (ventrosuspension), from the uterosacral ligaments, or from the sacral promontory. Laparoscopic ventrosuspension involves suturing of the round ligament to the rectal sheath; however, this is associated with a poor success rate, with one case series of nine women reporting recurrence of prolapse in eight women within 3 months of surgery. Laparoscopic uterosacral plication, first described in 1997, involves placing three purse-string sutures from the uterosacral ligaments to the posterior cervix. Wu reported a case series of seven women with no recurrence of prolapse at 9–17 months follow-up. Laparoscopic suture hysteropexy with closure of the pouch of Douglas and plication and reattachment of the uterosacral ligaments to the cervix has been reported by Maher et al., with an objective success rate of 79% in 43 women after a mean follow-up of 12 months. More recently, Cutner et al. have described a technique of laparoscopic uterine suspension by passing a Mersilene tape through the uterosacral ligaments to resuspend the uterus to the sacral promontory bilaterally: the initial results appear promising, but further evaluation of this technique is necessary. Laparoscopic hysteropexy, as described in this report, is a laparoscopic variation of the open procedure, involving suspension of the uterus from the sacral promontory using bifurcated polypropylene mesh, originally established by Leron and Stanton in 2001.

The management of uterovaginal prolapse in young women who wish to retain childbearing potential poses a particular challenge and dilemma for the reconstructive pelvic surgeon. No ideal procedure has been described so far. The effects of pregnancy and of delivery on any reconstructive procedure are poorly understood, and surgery prior to the completion of childbearing should be approached with caution. Most reconstructive procedures...
are designed for older women in whom fertility is not an important factor. In our own case series, three women were keen to have children in the future. None of them has become pregnant so far. One 19-year-old woman was born with bladder extrophy, as a result of spina bifida, and had a grade-4 uterine prolapse. Two other women in their early thirties both had one child each, and suffered significant symptomatic uterine prolapse. They were carefully counselled regarding management options, and were advised to defer prolapse repair surgery until their family was complete. However, because of severity of their symptoms, they opted for surgical correction of uterine prolapse. No pregnancies and deliveries after hysteropexy or similar procedures have been described in the literature.

Theoretically, the mesh we place around the cervix could cause constriction of the uterine artery as the uterus expands during the pregnancy, which could then compromise the blood supply to the myometrium, and cause impairment of the placental function. However, because of the rich blood supply to the uterus this is unlikely to occur. Uterine artery ligation and embolisation procedures for postpartum haemorrhage both appear to have no detrimental effect on subsequent reproductve function, as successful full-term pregnancies have been described in the literature following those procedures. Nevertheless, it would be appropriate to monitor fetal growth and placental function with regular scans during any pregnancy following a hysteropexy. In our study, all women of childbearing age undergoing hysteropexy were advised to be delivered by Caesarean section, should they subsequently become pregnant. The mesh completely encircles the cervix and will prevent its dilation during labour. It will, in fact, act as a conventional Shirodkar suture.

The aim of our surgical technique of laparoscopic hysteropexy has been to restore and reinforce normal uterine support by suspending the uterus from the sacral promontory using polypropylene mesh. The mesh is strongly attached at two points: namely the uterus/cervix and the anterior longitudinal ligament over the sacral promontory. This procedure allows the length of the vagina to be restored without compromising its calibre, and is therefore likely to have a favourable functional outcome. Interestingly, for the majority of patients in our study, restoration of uterine (apical) support has led to a significant reduction in anterior vaginal wall prolapse (Table 4). This is consistent with the suggested importance in restoration of level-1 (apical) support in cystocele repair. During the follow-up period, all our patients maintained good anatomical support for the uterus, and a functional vagina of normal length. All were sexually active before their operations and remained so afterwards. Two patients, who had undergone concomitant posterior colpoperineorrhaphy and laparoscopic hysteropexy, developed dyspareunia postoperatively. Both described a pain located over the posterior vaginal wall, later confirmed on clinical examination, suggesting that it most likely resulted from the posterior colpoperineorrhaphy.

The use of a synthetic mesh means that there is always a theoretical risk of erosion of an adjacent intraperitoneal structure, or adhesion of bowel to it, with subsequent development of symptoms and signs of acute or chronic obstruction. In our study of laparoscopic hysteropexy, no cases of erosion, infection or rejection of the polypropylene mesh have occurred so far. The technique of complete mesh peritonisation that we now use should reduce the risk of adhesions significantly. The use of type-1 meshes in pelvic reconstructive surgery is well established for sacrocolpopexy and suburethral sling procedures, and is known to be associated with the lowest risk of erosion or rejection.

In our practice, the demand for uterine preservation during surgical management of uterovaginal prolapse is increasing. However, the current body of medical literature on this subject is inadequate to assist physicians in determining which patients are ideal candidates for uterine preservation, and in selecting the ideal uterus-sparing procedure for a given patient. At present, the decision is usually influenced by the patient’s preferences and the surgeon’s skills and experiences. Well-designed comparative studies of pelvic floor reconstruction, both with and without hysterectomy, are currently not available. Studies involving more patients, longer follow-up times, appropriate controls and objective assessment techniques are necessary before uterine preservation can routinely be recommended at the time of uterovaginal prolapse surgery. The current literature suggests that uterine preservation at the time of pelvic reconstructive surgery may be considered in appropriately selected women who desire it. It is imperative, however, that those women fully understand the ongoing possibility of incurring uterine and cervical pathology over time, and the need for continued, routine surveillance measures to assess for such pathology.

Although our observational study cannot by its nature provide conclusive evidence, we are most encouraged by its finding that laparoscopic hysteropexy is effective in correcting uterine prolapse without recourse to hysterectomy. Should any patient require a hysterectomy in the future, we believe the mesh could easily be cut when dividing the uterosacral pedicles. It is also our impression that laparoscopic hysteropexy provides considerably stronger apical support when compared with vaginal hysterectomy. These initial findings need to be confirmed in a robust, prospective, randomised controlled trial, with a longer follow-up period. We are continuing to assess the outcome of this procedure.

**Conclusions**

There is a growing body of evidence supporting the concept of uterine preservation at the time of uterovaginal prolapse.
prolapse surgery. Although limited by its lack of a control group and its short follow-up period, the initial results on our surgical technique of laparoscopic hysteropexy show that it is a feasible and effective procedure for correcting uterine prolapse without recourse to hysterectomy. It allows restoration of the vaginal length without compromising its calibre, and is therefore likely to have a favourable functional outcome.

A prospective randomised clinical trial with long-term follow-up is needed to further evaluate and compare the outcomes of laparoscopic hysteropexy with traditional procedures, such as vaginal hysterectomy, for surgical treatment of uterine prolapse, in terms of anatomical cure, symptomatic cure and functional outcome.

**Disclosure of interest**
The authors have no conflicts of interest to disclose.

**Contribution to authorship**
The surgical technique for laparoscopic hysteropexy, as described in this report, was developed by AS and SRJ at the John Radcliffe Hospital, Oxford. The study itself was conceived, designed, implemented and reported jointly, and in equal measure, by NP and SRJ.

**Details of ethics approval**
No ethical approval was required for this investigation as it was a simple observational study (clinical audit).

**Funding**
None.

**Supporting information**
The following supplementary materials are available for this article:

**Video S1:** A short video film illustrating the surgical procedure for laparoscopic hysteropexy.

Additional Supporting Information may be found in the online version of this article.

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