



# Long-term anatomic and functional results of laparoscopic sacrocolpopexy: a prospective study

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## Abstract

**Purpose** The aim of our study was to assess the impact of laparoscopic sacrocolpopexy on pelvic symptoms, quality of life and sexual function in patients with symptomatic pelvic organ prolapse. Secondary goals included the assessment of anatomical correction, recurrence and complication rates.

**Methods** This is a prospective, single-center study that included 82 patients between 2009 and 2016. A clinical evaluation took place before surgery, and was repeated at 3, 12, 36 and 60 months postoperatively. Patients routinely received an anterior prosthesis, associated with a posterior prosthesis in case of symptomatic rectocele. Patients included self-administered questionnaires for functional pelvic problems (PFDI-20), quality of life (PFIQ-7), and sexual function (PISQ-12), and a clinical examination with POP-Q staging, at each medical visit.

**Results** Functional pelvic problems derived from prolapse (PFDI-20 scores) and their impact on patients' quality of life (PFIQ-7 score) significantly improved at 3, 12, 36 and 60 months postoperatively. Improvement on sexual activity was significant at 3 and 60 months postoperatively. Effective prolapse anatomical correction (POP-Q score < 2) was found in 94.4% and 97.2% of patients at the anterior and middle stages, respectively, at the end of follow-up, but only in 80.3% at the posterior stage. Symptomatic recurrence required surgical intervention in 4 patients (5.3%).

**Conclusions** This long-term follow-up prospective analysis confirms the good functional and anatomical results of laparoscopic sacrocolpopexy for pelvic organ prolapse.

**Keywords** Pelvic organ prolapse · Laparoscopy · Quality of life · Sexuality · Long-term adverse effects

## Introduction

Pelvic organ prolapses (POP) constitute pelvic stability problems that cause functional impairment with potential genital, urinary, anorectal and sexual impact. It is a common pathology in the female population, with an overall

prevalence around 40% [1]. POP is responsible for symptoms that strongly decrease women's quality of life (QoL), justifying surgical intervention in 19% of patients [2]. There are two surgical approaches for POP treatment, vaginal or abdominal. The latter is currently carried out by the sacrocolpopexy gold standard technique, which consists in the prosthetic fixation of pelvic organs to the anterior longitudinal ligament. This procedure has been performed for many years by laparotomy, with excellent results [3]. Laparoscopic sacrocolpopexy (LS) is a minimally invasive alternative, with reported advantages of reduced hospitalisation and convalescence periods, and at least similar results [4]. Several studies have shown that treating prolapse with LS leads to significant improvement on pelvic symptoms, as well as on their impact on quality of life, up to 1 year after surgery [5, 6]. Only a few studies monitored its impact on the medium (3 years) [7], and on the long term (over 5 years) [8].

Interestingly, anatomical correction of a prolapse is not always correlated with functional improvement [9]. Pelvic

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symptoms and their impact on patient QoL can be measured using short versions of self-administered questionnaires validated by the International Continence Society: the Pelvic Floor Distress Inventory (PFDI-20) for pelvic symptoms, the Pelvic Floor Impact Questionnaire (PFIQ-7) for the influence on QoL, and the Pelvic Incontinence Sexual Questionnaire (PISQ-12) for sexual function [10, 11].

The aim of our study was to assess the long-term impact of LS prolapse treatment on pelvic symptoms, quality of life and sexual function of patients operated on for POP-Q stage 2 or higher symptomatic prolapse. Secondary goals included the assessment of anatomical correction, as well as recurrence and complication rates.

## Methods

### Subjects

This is a prospective, single-center study that included 82 patients between 2009 and 2012. All subjects were above 18 years old, and presented a minimum POP-Q stage 2, according to the Pelvic Organ Prolapse Quantification international classification. Exclusion criteria included history of pelvic radiation therapy, need for a total hysterectomy in the same operative time and the occurrence of intraoperative vaginal or rectal injury. All patients signed a written consent, and the study was approved by the Ethics Committee (08.561).

### Surgical technique

A standardised subvesical anterior prosthesis technique was used, combined with a pre-rectal posterior prosthesis in case of associated rectocele POP-Q stage > 2 symptomatic or not. We used precut polypropylene prostheses (Surgimesh® Prolapse, Aspide Médical, La Talaudière, France), and non-absorbable fixation sutures (Flexidene®, B. Braun Medical). The anterior prosthesis was attached to the vaginal wall (5 sutures) and the uterine isthmus (1 or 2 sutures), and the posterior prosthesis to the levator ani muscles on its lower end, and to the uterosacral ligaments and the uterine isthmus on its upper end. The prosthesis was then attached to the promontory (2 sutures). The peritoneum was used to cover the mesh and closed with absorbable barbed sutures (V-lock®, Covidien). All procedures were conducted by the same operating surgeons with a minimal previous experience of at least 30 laparoscopic sacrocolpopexy surgeries. A suburethral band was additionally placed if the patient suffered from stress urinary incontinence. No subtotal hysterectomy were performed during the same procedure.

### Patients' assessment

A standard clinical evaluation by the operating surgeon was conducted at inclusion, and at 3, 12, 36 and 60 months after surgery, during medical follow-up visits. General data such as age, weight, height, gynaecological and obstetric history were registered via a standardised form. At each visit, PFDI-20, PFIQ-7 and PISQ-12 self-administered questionnaires were filled out, and a precise simplified POP-Q grading of each compartment was performed using a single-use hysterometer (CH10 flexible hysterometer, Laboratoire C.C.D, Paris, France). This considered three anatomical points for each compartment: anterior vaginal wall (Ba), posterior vaginal wall (Bp) and cervix (C). Severity of pelvic symptoms was assessed with questionnaire PFDI-20, and its 3 sub-questionnaires: the POPDI, the UDI and the CRAD. Patient functional impairment is correlated to PFDI-20 scores. The impact on QoL was assessed with questionnaire PFIQ-7 and its 3 sub-questionnaires: the POPIQ, the UIQ and the CRAIQ. The higher the obtained scores, the greater the impact on patients' QoL. To assess the impact on sexual function, we used the PISQ-12. Improved sexuality is also associated with a higher PISQ-12 score. General features of these questionnaires are summarised in Table 1.

Recurrence was defined by a postoperative POP-Q prolapse stage of 2 or higher [the point of the most distal prolapse determined in between 1 cm above and 1 cm below the hymenal plane (at least one point: - 1, 0 or + 1)]. This was assessed on all patients at the end of the follow-up period, and compared between patients with single or dual prostheses.

### Statistical analysis

Quantitative parameters are represented as mean and standard deviation. Qualitative parameters are expressed as numbers and percentages. Obtained scores for each questionnaire were analysed by means of a repeated measures ANOVA, in order to compare the results between study times for each patient. Analyses of significant differences were completed by a Tukey's post hoc test. When pertinent, other statistical comparisons between groups were carried out with a Student's *T* test for paired samples. Statistical significance was determined by a *p*-value < 0.05. All tests were carried out with IBM SPSS Statistics for Macintosh, Version 23.0. (Armonk, NY: IBM Corp).

## Results

General data regarding the 75 patients (91.46%) who fully completed follow-up are detailed in Table 2. Of the 7 patients lost to follow-up (8.54%), 5 did not attend the 60 months visit because they were asymptomatic and lived

**Table 1** Features of the self-administered assessment questionnaires and sub-questionnaires used in this study

Questionnaires	Sub-questionnaires	Questionnaire name	Number of questions	Symptom or problem assessed	Total score
PFDI-20	3	Pelvic floor distress inventory	20	Pelvic symptoms	300
	POPDI-6	Pelvic organ prolapse Distress Inventory	6	Vaginal symptoms	100
	UDI-6	Urinary Distress Inventory	6	Urinary symptoms	100
	DDI-8	Defecation Distress Inventory	8	Anorectal symptoms	100
PFIQ-7	3	Pelvic Floor Impact Questionnaire	21	impact of symptoms on quality of life	300
	UIQ-7	Urinary Impact Questionnaire	7	impact of urinary symptoms on quality of life	100
	POPIQ-7	Pelvic Organ Prolapse Impact Questionnaire	7	impact of pelvic symptoms on quality of life	100
	CRAIQ-7	Colo-Recto-Anal Impact Questionnaire	7	impact of anorectal symptoms on quality of life	100
PISQ-12	0	Pelvic Incontinence Sexual Questionnaire	12	Impact on sexuality	100

**Table 2** Preoperative demographics of the studied population

Age in years, mean (SD)	58.9 (± 9)
Body mass index (BMI), mean (SD)	24.4 (± 3.5)
Obstetrical history	
Parity, mean (SD)	2.2 (± 0.8)
Hysterectomy, n (%)	7 (9.3)
History of urinary incontinence treatment, n (%)	6 (8.0)
History of surgical treatment of pelvic prolapse, n (%)	7 (9.8)
Associated urinary incontinence	
Stress, n (%)	29 (40.0)
Urge incontinence, n (%)	14 (19.7)
Revealed, n (%)	13 (17.9)
Associated constipation, n (%)	27 (38.0)
Anal incontinence, n (%)	11 (13.5)

far away, 1 patient died of cancer, and another one voluntarily quit the study because of major perineal pain related to a suburethral TVT tape that subsequently had to be partially removed. There were no significant differences between the analysed cohort of patients and those lost to follow-up. Lost to follow-up patients were contacted by phone and no complications or symptoms were reported.

All scores are summarised in Tables 3 and 4, and illustrated in Fig. 1. The severity of pelvic symptoms was assessed with questionnaire PFDI-20. A statistically significant improvement was found for the global PFDI-20 score at 3, 12, 36 and 60 months, compared to the preoperative score ( $p < 0.001$ ). For POPDI and UDI, the score improvement was also significant at 3, 12, 36 and 60 months,  $p < 0.001$ . CRAD scores improved postoperatively but not significantly ( $p = 0.435$ ).

Concerning the impact on quality of life, a statistically significant improvement for the overall PFIQ-7 score, as well as for the sub-questionnaires POPIQ and UIQ, was

**Table 3** PFDI-20 and PFIQ-7 scores determined at the different clinical assessment visits mean (SD)

	Preoperative	3 months	12 months	36 months	60 months
PFDI-20	93.0 <sup>†</sup> (49.65)	42.86* (34.97)	40.65* (36.73)	36.42* (38.18)	47.63* (45.8)
POPDI-6	40.36 <sup>†</sup> (19.96)	8.51* (11.89)	9.98* (13.19)	9.74* (14.25)	12.91* (15.02)
UDI-6	31.97 <sup>†</sup> (24.59)	13.65* (17.52)	13.88* (17.35)	12.73* (16.13)	17.41* (20.69)
CRADI-8	20.66 <sup>†</sup> (20.05)	16.40 <sup>NS</sup> (17.96)	16.57 <sup>NS</sup> (13.76)	13.95 <sup>NS</sup> (14.43)	17.29 <sup>NS</sup> (16.78)
PFIQ-7	145.0 <sup>†</sup> (56.72)	114.21* (33.72)	114.01* (30.0)	113.27* (28.0)	119.60* (42.62)
POPIQ-7	51.71 <sup>†</sup> (30.89)	37.18* (11.53)	38.64* (13.63)	37.22* (11.29)	38.09* (11.94)
UIQ-7	59.19 <sup>†</sup> (29.33)	40.83* (14.49)	34.39* (12.15)	33.26* (9.39)	40.34* (15.69)
CRAIQ-7	33.10 <sup>†</sup> (25.93)	38.61 <sup>NS</sup> (13.91)	37.07 <sup>NS</sup> (9.09)	37.80 <sup>NS</sup> (12.56)	42.31 <sup>NS</sup> (21.2)

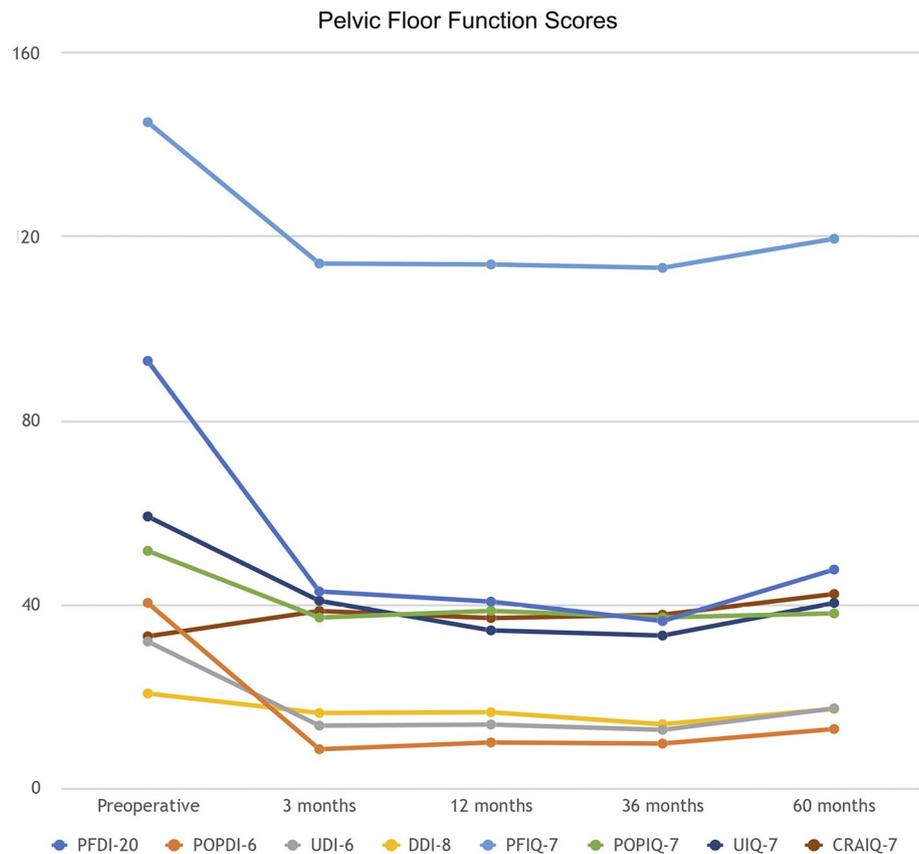
<sup>†</sup>Reference scores. \* $p < 0.001$ , when compared to preoperative scores. NS:  $p > 0.05$ , absence of statistical significant differences when compared to preoperative scores. (ANOVA for repeated measures, Tukey's post hoc test)

**Table 4** PISQ-12 questionnaire scores throughout the study mean (SD)

	Preop.	3 months	12 months	36 months	60 months	<i>p</i>
Sexual desire	2.7 <sup>†</sup> (1.0)	2.3 (1.1)	2.5 (0.8)	2.2 (0.9)	2.2 (0.9)	0.734
Frequency of orgasms	2.5 <sup>†</sup> (1.2)	2.5 (1.3)	2.6 (1.1)	2.6 (1.1)	2.9 (1.0)	0.855
Sexual arousal	2.6 <sup>†</sup> (1)	2.4 (1.2)	2.8 (0.9)	2.8 (1.1)	2.5 (0.6)	0.841
Sexual satisfaction	2.5 <sup>†</sup> (1.2)	2.7 (1.1)	3.0 (0.9)	2.9 (1.1)	2.6 (1.0)	0.462
Dyspareunia	2.7 <sup>†</sup> (1.2)	2.7 (1.1)	2.9 (1.1)	3.0 (1.1)	3.0 (1)	0.770
Coital urinary incontinence	3.4 <sup>†</sup> (0.9)	3.4 (1.0)	3.8 (0.6)	3.9 (0.3)	3.7 (0.4)	0.069
Fear of having coital urinary incontinence	3.4 <sup>†</sup> (1.1)	3.5 (1.1)	3.8 (0.4)	3.9 (0.2)	3.9 (0.3)	0.018
Avoiding intercourse due to intravaginal bulge	2.5 <sup>†</sup> (1.4)	3.7 (0.7)	3.8 (0.4)	3.8 (0.5)	3.8* (0.4)	<0.001
Avoiding intercourse due to negative emotions during intercourse	2.8 <sup>†</sup> (1.4)	3.4 (1.2)	3.8 (0.6)	3.7 (0.5)	3.7* (0.5)	<0.001
Partner erection problem	3.2 <sup>†</sup> (1.0)	3.1 (1.1)	3.4 (0.9)	3.2 (1.0)	3.2 (1.0)	0.673
Partner early ejaculation problem	3.3 <sup>†</sup> (1.1)	3.2 (1.1)	3.5 (0.9)	3.5 (0.9)	3.5 (0.8)	0.608
Comparison of the amount of orgasms between the past and now	2.9 <sup>†</sup> (0.8)	2.1 (1.2)	2.2 (1.0)	2.7 (0.8)	2.8 (0.7)	0.050
Total score	34.9 <sup>†</sup> (5.7)	36.4** (6.0)	37.5 <sup>NS</sup> (5.0)	37.8 <sup>NS</sup> (5.3)	36.6*** (6.1)	

<sup>†</sup>Reference values for comparison with each follow-up period. \* $p < 0.05$ , when compared to preoperative scores. \*\* $p = 0.02$ , when compared to preoperative scores. \*\*\* $p = 0.037$ , when compared to preoperative scores. NS:  $p > 0.05$ , absence of statistical significant differences when compared to preoperative scores. (ANOVA for repeated measures, Tukey's post hoc)

**Fig. 1** Improvement curves for all self-administered questionnaires throughout the study. A significant improvement in scores was observed as early as 3 months after surgery. Stability of scores throughout the study is also clear, at all follow-up times



observed at 3, 12, 36 and 60 months ( $p < 0.001$ ). CRAIQ improved postoperatively although not significantly at 3, 12 and 36 months ( $p = 0.374$ ), and no further improvement was observed at 60 months.

Absence of sexual activity was reported by 11 patients preoperatively, 13 patients at 3 months, 19 patients at 36 months and 20 patients at 60 months postoperatively. The mean PISQ-12 preoperative score was 34.9 ( $\pm 5.7$ ). During

follow-up, this score improved significantly at 3 ( $p=0.02$ ), and 60 months ( $p=0.037$ ) compared to preoperative data. When analysing each PISQ-12 question separately, we observed significant 60-month improvement in sexual symptoms in the following two items: avoidance of intercourse due to prolapse and avoidance of intercourse due to negative emotions during sexual activity. There was no improvement at 60 months for questions concerning the partner's sexuality.

Score fluctuations were observed throughout the follow-up period, with best functional improvement being observed at 36 months, and best quality of life as well as sexual activity scores occurring at 12 months postoperatively. No statistical significant differences were found between the different postoperative follow-up times.

The number of sexually active patients complaining of dyspareunia before surgery was 21. An early decrease in this symptom was observed at 3 months postoperatively, with only 9 patients reporting mild pain during intercourse. This number remained stable with, respectively, 7 patients at 12 months, and 8 patients at 60 months.

No vaginal or rectal injuries occurred during surgery. One vesical lesion was immediately sutured and did not contraindicate mesh implantation. There were three mesh-related complications. Those complications were managed by surgical partial removing of tape. Two patients presented with mesh exposure, and one patient complained from painful foreign body sensation. Prosthesis unrelated complications included one intestinal obstruction due to fibrous bands, and one umbilical hernia.

Anatomical recurrence rates are summarised in Table 5. The 60-month assessment found a POP-Q stage  $\geq 2$  prolapse in 14 patients (18%) on the posterior stage, in 6 patients (8%) on the anterior stage and 2 patients (2%) on the middle stage. The overall anatomical correction rate (POP-Q stage 0 or 1) was 70.7%, and the percentage of subjective improvement (women without symptoms) was 89.3%. 4 patients were re-operated, 2 for symptomatic recurrence on the posterior stage, and 2 due to fixation loosening on the middle stage. Two other patients reported the recurrence of anterior stage symptoms but refused to undergo any corrective procedures. This corresponds to a 5.3% rate of surgical reintervention for symptomatic recurrence.

In the subgroups of single (24 patients) or double (46 patients) prosthesis, the posterior stage anatomical recurrence rates at 60 months were, respectively, 16% (4/24) and 21.7% (10/46), with no statistical differences found between both groups ( $p=0.089$ ). Recurrence was herein defined by intravaginal POP-Q stage 2, but none of the patients experienced any impairing symptoms.

## Discussion

This long-term follow-up study shows that significant clinical improvement on pelvic organ prolapse obtained by laparoscopic sacrocolpopexy remains stable 5 years after surgery, regarding pelvic symptoms and patient's quality of life, as well as sexual function. Moreover, a positive prolapse cure rate was observed, along with an extremely low percentage of recurrences demanding surgical reintervention.

To our knowledge, this is the first long-term prospective study based on specific and validated self-administered questionnaires precisely assessing the impact of laparoscopic sacrocolpopexy on POP's functional symptoms and quality of life.

In our study, we found a strict anatomical correction (POP-Q stage  $< 2$ ) rate of 70.7% 5 years after surgery, which is comparable to the 70% at 1 year found by Claerhout and colleagues [12]. Subjective patient cure rate was 89.3% at 60 months; this rate does not differ substantially from the Sarlos team series (95.3%) who carried out a similar follow-up [13].

Nonetheless, our primary outcome measure remains the correction of symptoms and their impact on patients' quality of life. Using the prolapse-related pelvic symptom assessment questionnaire (PFDI-20), our results showed an early (3 months), as well as a long term (60 months), significant improvement in genital and urinary symptoms. With the use of the PFIQ-7 questionnaire, we were also able to show a clear improvement on overall quality of life. The analysis of the sub-questionnaires showed specific improvement on genital and urinary parameters. However, the differences in decreased anorectal clinical symptoms and better QoL were not significant. In this cohort, patients presented a predominant urogenital prolapse, with less anorectal complaints,

**Table 5** Clinical assessment during medical visits at each anatomical stage  $n$  (%)

	Preoperative	3 months	12 months	36 months	60 months
Ba $\geq -1$ cm	76 (92.0)	3 (4.0)	4 (5.0)	3 (4.0)	6 (8.0)
Bp $\geq -1$ cm	37 (45.0)	15 (20.0)	21 (28.0)	16 (21.0)	14 (18.0)
C $\geq -1$ cm	66 (71.7)	2 (2.0)	5 (6.0)	1 (1.0)	2 (2.0)

Measurements are carried out using an hysterometer (CH10 flexible hysterometer, Laboratoire C.C.D, Paris, France), during medical visits. According to POP-Q classification, at least one point  $-1$ ,  $0$  or  $+1$  constitutes a stage 2 prolapse. As so, any measurement obtaining at least one point  $\geq -1$  will define a minimal POP-Q stage 2, and thus a recurrence of preoperative prolapse

which could explain the overall improvement despite a less significant progress on the posterior stage. Furthermore, it is clear that the use of the laparoscopic sacrocolpopexy technique leads to significant improvement of functional impairment, which constituted our patients' major preoperative concern.

Regarding sexual function, the obtained mean overall score for the PISQ-12 questionnaire is in accordance with available published data [14]. Our results also confirmed the negative effect of urogenital prolapse on sexuality [15]. The effect of physical changes associated with pelvic organ prolapse on a woman's body image and how that may influence sexuality has not been well documented. In 2009, Zielinski et al. [16] carried out an assessment of implementation and utility of a body image questionnaire (VSBE) in women with pelvic organ prolapse. Data showed that sexually active women with pelvic organ prolapse scored significantly lower on the VSBE scale than women who were not sexually active, with a positive correlation between severity of prolapse and VSBE scores. Similarly, Lagana [17] reported pelvic organ prolapse as a negative impact factor on quality of life and psychological well-being. In the our preoperative evaluation, we also found that pelvic organ prolapse and its severity had an impact on women's quality of life and sexual function.

In the present study, laparoscopic sacrocolpopexy improved all aspects of sexuality related to the direct anatomical impact of POP (vaginal bulge) without increases in the quality of sexual intercourse (frequencies, orgasms, desire, excitement) or partner's sexual capacity (erection, ejaculation) [14]. Our patients' sexual activity remained relatively stable during the 60 months of follow-up, and no age-related decline was observed. However, further studies would be necessary to eliminate decreased sexuality confounding factors, such as ageing, in women with pelvic prolapse. Our results also confirm those found in other published series [7, 18], and highlight the absence of negative impact on sexuality after laparoscopic sacrocolpopexy compared to prosthetic POP surgery by vaginal approach [19, 20]. Whilst the latter has the undeniable advantages of low operative morbidity, vaginal scarring still stands as its greatest weak point, along with induced changes in sensitivity, especially in the case of prosthesis implantation. Although some authors showed that they can propose approaches that allow for the preservation of sexual function [21], most studies show a detrimental effect on its quality [22]. Alternatively, studies have been published on the improvement of women's quality of life and sexuality after prolapse surgery by vaginal route. In a first study, Vitale et al. [23] reported significant QoL improvement on 20 women after biocompatible porcine dermis graft, as well as on behavioural emotive, physical, partner-related and total PISQ-12 scores, at the end of a

12-month follow-up. In another study [24], they assessed the impact of prolapse surgery using transvaginal bilateral sacrospinous fixation. They found a significant anatomical improvement in 4/5 POP-Q landmarks but also on QoL and sexuality using, respectively, SF-36 and PISQ-12 scores. In a third publication [25], the same team refocused on quality of life (SF36) and sexual changes (PISQ12) after double transobturator tension-free approach to severe cystocele in 23 women after a 12-month follow-up. SF-36 and PIQ-12 showed significant increased global scores in all of the categories compared to baseline. With our abdominal laparoscopic approach, we observed a similar global tendency towards the improvement of QoL and sexuality, on a larger cohort and with a longer follow-up. Further discussion on the usefulness of a comparison of sexual impact between both vaginal and abdominal approaches to pelvic prolapses should lead to other studies.

The comparison of results between the patients with an anterior subvesical prosthesis alone, and those with both anterior and posterior prostheses, did not find significant differences in terms of relapse at the posterior stage. Choosing not to proceed with a posterior implant in the absence of significant rectocele (POP-Q stage < 2) did not seem to significantly influence the risk of posterior relapse on the long term. Our anatomical assessment showed a 5-year asymptomatic intravaginal relapse rate of 19.6% for the posterior stage. This percentage may appear high but it actually corresponds to low rectoceles, which are usually insufficiently corrected by laparoscopic approach. In a series of laparotomy sacrocolpopexies associated with Burch colposuspension [26], a prophylactic surgical procedure on this compartment was initially motivated by a high relapse rate (rectocele or enterocele). Several groups have questioned this attitude, raising concern regarding the implication of cervicocystopexy (Burch procedure) in the occurrence of secondary rectocele [27]. An additional argument against routine implantation of a posterior prosthesis is the risk of specific rectal complication (haematoma, rectal injury, denervation) [12], which is difficult to justify when no comparative randomised trial as proven it to be beneficial. Data from our prospective 5-year study support the current therapeutic trend to decrease prophylactic indications for posterior prosthesis [28].

The greatest limitation of this long-term follow-up study lies on the single-centre recruitment reported here, of patients previously included in a multicentre prospective study [5]. Our strength resides in the prospective and standardised data collection, and in its considerable 60 months of follow-up. Other strong points are the use of a standardised surgical technique for all surgeons and the stability of our cohort, with only 8.54% of lost to follow-up.

## Conclusions

This prospective, long-term, single-center study confirms the good results of the laparoscopic sacrocolpopexy technique in terms of improvement in pelvic symptoms, quality of life and sexual function, as well as anatomical correction of pelvic organ prolapse. The early onset improvement remained stable on the long term, during the first 5 postoperative years. These data further support laparoscopic sacrocolpopexy as the standard surgical technique for pelvic organ prolapse correction.

**Author contributions** LW: Protocol and project development, data analysis, manuscript writing and editing. AC: manuscript writing and editing. EL: Protocol development, data collection and management. PC: Data collection and management. SD: Protocol and project development, data analysis.

## Compliance with ethical standards

**Conflict of interest** The authors declare that they have no conflict of interest.

**Ethical approval** All procedures were in accordance with the ethical standards of the institutional Ethics Committee (08.561), and with the 1964 Helsinki declaration and its later amendments.

**Informed consent** Informed consent was obtained from all individual participants included in the study.

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