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ORIGINAL ARTICLE

New kid on the block: perineal stapled prolapse resection (PSP) is it worthwhile in the long-term?

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Abstract
Purpose Perineal stapled prolapse resection (PSP) has been described as a new surgical treatment for external rectal prolapse in 2008. Short-term and midterm results acknowledged PSP as a safe, fast and simple procedure for high-risk patients. This study aims to assess long-term results after PSP.
Methods All patients who underwent PSP from 2007 to 2015 were analyzed retrospectively. Data was gathered from medical records and operative reports and by interviews with the general practitioner or the patient.
Results Indication for PSP was provided in 64 cases. One procedure had to be changed to an Altemeier's and another to a laparoscopic rectopexy. The median age was 79.9 years (range 25.9–97.5). Spinal anaesthesia was used in 19 patients. The median operation time was 32.5 min (range 25–51.2). There was no mortality. One patient had to be reoperated. All other complications were minor. The median hospital stay was 6.0 days (range 2–23). Median follow-up of patients alive was 6.0 years (range 0.2–8.4). The 5-year recurrence-free survival rate for primary prolapse was 70.1 % compared to 34.3 % for recurrent prolapses ($p = 0.048$). Further positive prognostic factors were specimen length over 8 cm and lack of preoperative obstructed defecation syndrome. Faecal incontinence was remedied in 18, and new onset was recorded in 6 patients (significant incontinence rate reduction ($p = 0.025$)).
Conclusion Due to low morbidity and the possibility of spinal anaesthesia, PSP is suitable for frail patients. The recurrence rate for primary prolapse is similar to alternative perineal procedures like Delorme's and Altemeier's, but inferior to the laparoscopic techniques.

Keywords Rectal prolapse · Perineal stapled prolapse resection · Surgical therapy · Perineal approach · PSP · Contour® Transtar™

Introduction

Perineal stapled prolapse resection (PSP) is a relatively new procedure used to treat complete external rectal prolapse. It was developed from stapled transanal rectal resection (STARR) which alleviates obstructed defecation syndrome by removing rectal intussusception with a Contour® Transtar™ stapler [1, 2].

External rectal prolapse is a protrusion of all layers of the rectal wall through the anus due to intussusception and appears with a characteristic circular fold of rectal mucosa [3]. The cause of the condition is still unclear. It affects predominantly females, and the incidence is highest in the 50 to 80 year olds. Rectal prolapse impacts the quality of life (QoL) of affected patients both through the presence of a protruding, mucous-secreting mass and the impairments of faecal continence and rectal voiding. Many are ashamed of the condition

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and avoid public places and social contact. Furthermore, it can lead to life-threatening complications [4–6].

Rectal prolapse can only be cured with an operative procedure. Surgical techniques can be divided into abdominal or perineal approaches. Abdominal operations through laparotomy or laparoscopy are frequently used for healthy, fit patients. The perineal approach is preferred in elderly, frail patients with many comorbidities or for strangulated and gangrenous rectal prolapse [5, 7]. The most popular perineal procedures are Altemeier's perineal rectosigmoidectomy, which is preferred in the USA, and Rehn-Delorme's procedure, more commonly performed in Europe [8], the former being relatively complex and time-consuming to perform [9] and the latter having the drawback of a high recurrence rate [5]. However, evidence about recurrence rate after perineal procedures is low; the only randomized controlled trial comparing the two procedures, so far, could not show any significant difference [8].

PSP is technically easy to perform, requiring a short operation time. This might make it a possible alternative to the commonly used perineal techniques [2, 10]. Furthermore, PSP showed good functional results especially concerning faecal incontinence [10, 11], except in one small study [12]. A part of the authors analyzed midterm recurrence rate in a partially overlapping patient collective [13]. According to our knowledge, no studies with adequately sized patient cohorts have assessed the long-term results.

The aim of this analysis was to assess the recurrence rate, functional outcome, risk factors for recurrence and QoL after PSP in the long term.

Material and methods

Patients' recruitment and follow-up

Patients, scheduled for PSP in a tertiary centre for coloproctology in Switzerland from August 2007 to October 2015, were enrolled in the analysis. The procedure was offered to all patients with complete rectal prolapse. The type of procedure was selected by the patient after information and discussion of advantages and drawbacks. PSP was recommended to those who were considered too frail or old for laparoscopic rectopexy. Furthermore, patients who opted against an abdominal procedure in light of possible sequelae (e.g. possible negative impact on fertility in young females) were treated by this means. Preoperative assessment and follow-up were conducted according to a predefined protocol. The patients were evaluated at the outpatient clinic, including patients' history and proctological examination before the operation. Obstructed defecation problems were assessed routinely, as well as incontinence symptoms using a Wexner score (Cleveland incontinence score) [14]. The operation was performed or instructed in a standardized way by two specially trained surgeons. All patients were seen at the outpatient clinic 4 weeks after the operation. Both an assessment of the functional outcome and a clinical examination with special focus on recurrent or persisting prolapse, when straining, were performed. Complications during the postoperative course were recorded routinely, according to the Dindo classification [15].

At the end of 2015, a data collection was conducted, assessing the electronic and paper records of the patients. Further information was collected in January 2016 by a phone interview with the general practitioner and/or the patient. Information was obtained regarding recurrence of rectal prolapse, persisting or worsening incontinence and obstructed defecation and change thereof. Further data was gathered concerning satisfaction with the procedure, willingness to undergo the operation again under the same circumstances and general QoL using Likert scales from 0 to 10. Additionally, a Wexner score and a QoL questionnaire (Rockwoods' Faecal Incontinence Quality of Life scale (FIQL)) [16] were filled out. Patients with unclear status concerning recurrence or other problems were invited to a clinical follow-up for further investigation and treatment.

All patients gave informed consent after receiving full explanation of the operation and the study. The study protocol was reviewed and accepted by the local ethics board and was registered under http://www.controlled-trials.com under the number ISRCTN68491191.

Operative technique and perioperative management

The perioperative care and the PSP operation were performed as reported in full elsewhere [2]. In summary, the completely extracted prolapse was opened with a linear stapler with one or multiple firings and then stepwise resected with a Contour® Transtar™ stapler parallel to the dentate line. The procedure is shown in Fig. 1. From 2009 onwards, the prolapse was opened on both sides lengthwise for better vision, as described by Romano et al. [17]. With this exception, all procedures were performed in the same standardized way. Except for an enema, no mechanical bowel preparation was done and oral food intake was continued right after the operation.

Statistical analysis

Statistical analyses were performed using the R statistical software (www.r-project.org). Main analysis was performed as an intention-to-treat analysis. A two-sided p value <0.05 was considered statistically significant. Continuous data are expressed as mean ± standard deviation and median and interquartile range (IQR). For comparing proportions and continuous variables, chi-square

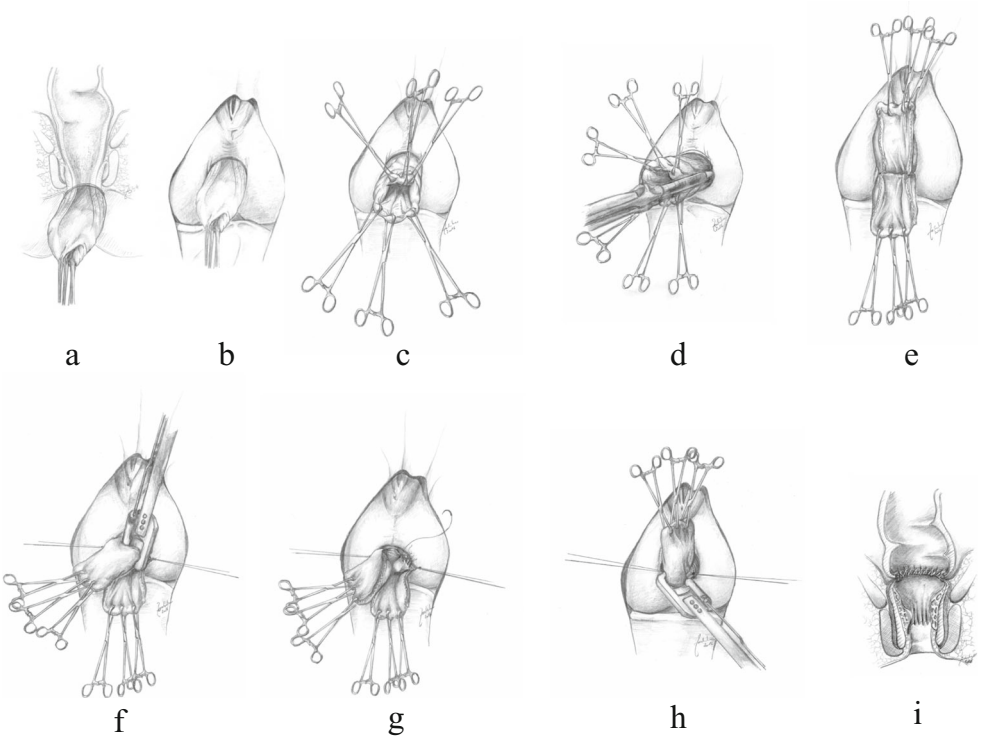

Fig. 1 A schematic drawing of the surgical technique of perineal stapled prolapse resection (PSP). **a**–**c** Exposition and fixation of the prolapse by Allis clamps. **d**, **e** Incision at 3 o'clock and 9 o'clock with a linear stapler. **f**–**h** Resection counterclockwise with a Contour® Transtar™ stapler parallel to the dentate line and interrupted absorbable monofilament suture of staple line. i Result after PSP

statistics and Mann-Whitney *U* tests were used as appropriate. Missing data were imputed using the random survival forest method [18].

Recurrence of prolapse was assessed as time to event data counting from the date of the operation. Any recurrence was counted as an event. First, recurrence of prolapse was assessed in a univariable Kaplan-Meier analysis. Thereafter, age, body mass index (BMI), type of narcosis, primary versus recurrent prolapse, length of the resected pathologic specimen, preoperative Wexner score and preoperative prevalence of obstructed defecation syndrome (ODS) (risk profile) were assessed as putative prognostic factors for recurrence-free survival in unadjusted and risk-adjusted Cox regressions. These included a backward variable selection procedure from the full Cox regression model based on the Akaike's information criterion. Age, length of the pathological specimen and preoperative Wexner score were included as dichotomized (median) variables. Relevant risk factors identified in this analysis were then further elaborated with propensity score analysis. This is a superior and more refined statistical method [19–22] of adjusting for potential baseline confounding variables using the "Matching" R package to perform a bipartite weighting propensity score analysis [23]. Finally, the risk profiles of the matched patients were compared to assure that no major differences persisted. Stratified Cox regression analyses were performed applying the subclasses and the weights obtained by the propensity score analyses.

Results

Baseline characteristics

The analysis was based on the 64 PSPs performed consecutively between August 2007 and October 2015 at the centre hospital of St. Gallen and the affiliated hospital Rorschach. Our institution is a public hospital network consisting of one centre hospital and several affiliated smaller hospitals. Only the two hospitals mentioned above were part of the network for the complete study period. Other affiliations terminated or began during the course of this analysis. All PSP procedures which were performed in these two hospitals were included in this long-term analysis. These were 41 PSP procedures of the former midterm analysis [13] and 23 further cases.

Intraoperative problems were encountered in nine (14.1 %) patients with a change of procedure in two patients. In one case, the procedure had to be converted to an Altemeier's rectosigmoidectomy due to malfunction of the stapler in an exceptionally thick and vulnerable prolapse. The staples did not close the rectal wall, and a large defect developed directly after the first firing of the curved stapler. A change of the procedure to a laparoscopic rectopexy became necessary on another patient, in whom the rectoanal junction could not be exposed adequately. In this case, the bigger part of the prolapse could be pulled out of the anus, but the anal canal and the region just above it were fixated and could not be exteriorized. The remaining intraoperative problems were minor and consisted of

possible small bowel adherence in the pouch of Douglas in four patients. This was excluded by opening it before resection. In further three patients, a minor dehiscence of the staple line was oversewn without further consequences.

Postoperative complications occurred in ten patients (15.6 %, grades I to III in four, five and one patients). The Dindo III complication occurred in the patient converted to Altemeier's, who had to be re-operated because of bleeding in the transsected mesorectum the following day.

A total of 19 patients experienced a recurrence after a median of 20.6 months (IQR 6.9 to 44.0 months, range 3.2 to 75.0 months) during follow-up. Of these, one patient died in the course of the follow-up. Table 1 summarizes the characteristics of the patients with and without recurrent prolapse and outlines the significant differences in age, primary vs. recurrent prolapse before the procedure and the length of the specimen before the pathological examination.

Follow-up

For patients alive at the end of the follow-up ($N=42$), median follow-up time was 6.0 years (IQR 2.5 to 6.9 years) ranging from 0.2 to 8.4 years. Mean follow-up time for patients alive ($N=42$) was 5.1 ± 2.6 years. A total of 22 patients (34.4 %) died after a median of 2.4 years (IQR 0.8 to 3.4 years) from non-related causes. The median follow-up of recurrence-free patients alive at the end of follow-up ($N=24$) was 4.6 years (IQR 1.0 to 6.6 years) and of patients with a recurrence alive ($N=18$) 6.6 years (IQR 5.8 to 7.3 years). Follow-up was almost complete. Of all patients, some follow-up data was available; in three, no new data was assessable in January 2016 because they, their next of kin and their general practitioner could not be reached. Of all the patients who died, information was obtained from the responsible nurses, the next of kin and/or the general practitioner about the situation just before death, especially concerning recurrence of prolapse.

Recurrent rectal prolapse after PSP

Recurrences were encountered in 19 of 64 cases (29.7 %). The 5-year recurrence-free survival rate was 54.4 % (95 % CI 40.2 to 73.6 %), corresponding to a recurrence rate of 45.6 %. At 2 years, the recurrence rate had only been 19.9 % (95 % CI 8.2 % to 29.4 %) (Fig. 2). A total of 16 of the 19 patients with recurrence were re-operated. Three received no additional operation due to patient's wish or reduced general condition. One patient underwent an Altemeier's rectosigmoidectomy in another hospital. A second PSP procedure was performed in two patients. The remaining 13 patients were treated subsequently with an anterior rectopexy, which was performed mostly laparoscopically. In the light of having suffered from a recurrence after PSP, these patients, although frail, opted for the somewhat riskier abdominal procedure. In neither of the two male patients did a recurrence occur. Previous recurrent prolapse (HR = 3.79, 95 % CI 1.35 to 10.63, $p=0.016$) and preoperative ODS (HR = 5.65, 95 % CI 1.24 to 25.72, $p=0.022$) increased the risk for recurrence. A pathologic specimen over 8 cm long was associated with a lower prolapse risk (HR = 0.25, 95 % CI 0.06 to 1.01, $p=0.044$). As a tendency, patients aged over 80 years had a decreased risk for recurrence (HR = 0.44, 95 % CI 0.14 to 1.39, $p=0.136$). The results of the multivariable analysis of risk factors for recurrence are summarized in Table 2.

The 5-year recurrence-free survival rate for the 33 patients aged less than 80 years was 48.2 % (95 % CI 32.0 % to 72.5 %) compared to 78.9 % (95 % CI 59.2 % to 100.0 %) in the 31 older patients. In the 54 patients with primary prolapse, the 5-year recurrence-free survival rate was 70.1 % (95 % CI 55.6 to 88.2 %) compared to 34.3 % (95 % CI 13.8 to 85.2 %) in the ten patients with recurrent prolapse. Of the 40 patients with a specimen longer than 8 cm, 68.8 % (95 % CI 50.2 % to 94.3 %) had no recurrence at 5 years compared to 53.7 % (95 % CI 35.9 to 80.3 %) of the 24 patients with a shorter specimen. Of the 21 patients with a prevalent ODS, only 50.6 % (95 % CI 28.2 % to 91.1 %) were without recurrence in contrast to 66.2 % (95 % CI 50.5 % to 86.8 %) of the remaining 43 patients. Figure 3 displays the time course of recurrence dependent on age, primary versus recurrent prolapse, length of the pathologic specimen and pre-existent ODS.

To further elaborate the findings from multivariable analysis, propensity score-matched analysis was performed. A tendency towards a lower rate of recurrence was encountered in patients with older age (HR = 0.20, 95 % CI 0.02 to 1.64, $p=0.076$). The effect of a higher recurrence rate in patients with pre-existing recurrent prolapse was not significant, due probably to a too low number of such patients (HR = 1.92. 95 % CI 0.60 to 6.17, $p=0.298$). The rate of recurrence was significantly increased in patients with pre-existent ODS (HR = 18.97, 95 % CI 2.16 to 166.9, $p=0.001$) and significantly decreased in patients with a longer pathologic specimen (HR = 0.15, 95 % CI 0.04 to 0.53, $p<0.001$).

Change of incontinence, Wexner score and ODS after PSP

A relief of incontinence occurred in 18 (38.3 %) of 47 patients with preoperative incontinence. In 6 of 17 (35.3 %) patients without a preoperative incontinence, a newly diagnosed incontinence was observed postoperatively. In summary, the rate of incontinence was significantly decreased ($p=0.025$). A relief of ODS occurred in 15 (71.4 %) of 21 patients with preoperative ODS. In one of 43 (2.3 %) patients without a preoperative ODS, a newly

Table 1 Patient characteristics

		Total ($N=64$)	No recurrence ($N=45$)	Recurrence ($N=19$)	p value
Age (years)	Median (IQR)	79.9 (68.2–84.7)	82.6 (67.8–86.4)	74.6 (69.1–79.9)	0.049[a]
	Mean (SD)	74.5 (16.7)	76.9 (15.2)	68.9 (19.2)	
	<80 years	33 (51.6 %)	18 (40.0 %)	15 (78.9 %)	0.005[b]
	80+ years	31 (48.4 %)	27 (60.0 %)	4 (21.1 %)	
Gender	Female	62 (96.9 %)	43 (95.6 %)	19 (100.0 %)	0.491[b]
	Male	2 (3.1 %)	2 (4.4 %)	0 (0.0 %)	
ASA score	ASA I/II	45 (70.3 %)	29 (64.4 %)	16 (84.2 %)	0.123[b]
	ASA III	19 (29.7 %)	16 (35.6 %)	3 (15.8 %)	
BMI (kg/m^2)	Median (IQR)	23.0 (20.0–26.0)	22.0 (20.0–25.0)	25.0 (22.5–26.0)	0.063[a]
	Mean (SD)	23.3 (4.3)	22.8 (4.5)	24.5 (3.5)	
	<25 kg/m^2	40 (62.5 %)	32 (71.1 %)	8 (42.1 %)	0.036[b]
	25+ kg/m^2	24 (37.5 %)	13 (28.9 %)	11 (57.9 %)	
Prolapse	Primary	54 (84.4 %)	42 (93.3 %)	12 (63.2 %)	0.006[b]
	Recurrent	10 (15.6 %)	3 (6.7 %)	7 (36.8 %)	
Operation (min) time	Median (IQR)	32.5 (25.0–51.2)	32.0 (27.0–60.0)	40.0 (20.0–45.0)	0.137[a]
	Mean (SD)	41.0 (26.1)	44.0 (29.4)	34.0 (14.4)	
	<30 min	22 (34.4 %)	13 (28.9 %)	9 (47.4 %)	0.174[b]
	30+ min	42 (65.6 %)	32 (71.1 %)	10 (52.6 %)	
Anaesthesia	General	40 (62.5 %)	27 (60.0 %)	13 (68.4 %)	0.545[b]
	Spinal	24 (37.5 %)	18 (40.0 %)	6 (31.6 %)	
Hospital stay (days)	Median (IQR)	6.0 (5.0–10.2)	7.0 (5.0–11.0)	6.0 (5.0–8.0)	0.544[a]
	Mean (SD)	7.9 (4.4)	8.1 (4.5)	7.4 (4.3)	
Length of specimen (cm) (before resection)	Median (IQR)	8.0 (6.0–10.0)	8.0 (6.0–10.0)	8.0 (6.0–9.0)	1.000[a]
	Mean (SD)	8.0 (2.9)	8.0 (3.1)	7.8 (2.4)	
	<8 cm	30 (46.9 %)	21 (46.7 %)	9 (47.4 %)	0.959[b]
	8+ cm	34 (53.1 %)	24 (53.3 %)	10 (52.6 %)	
Length of specimen (cm) (before pathological processing)	Median (IQR)	8.0 (7.0–9.0)	8.0 (7.0–9.0)	7.0 (6.5–8.0)	0.031[a]
	Mean (SD)	8.0 (1.6)	8.2 (1.6)	7.6 (1.7)	
	<8 cm	24 (37.5 %)	12 (26.7 %)	12 (63.2 %)	0.008[b]
	8+ cm	40 (62.5 %)	33 (73.3 %)	7 (36.8 %)	
Intraoperative complications	No	55 (85.9 %)	41 (91.1 %)	14 (73.7 %)	0.095[b]
	Yes	9 (14.1 %)	4 (8.9 %)	5 (26.3 %)	
Incontinence preoperatively	No	17 (26.6 %)	13 (28.9 %)	4 (21.1 %)	0.545[b]
	Yes	47 (73.4 %)	32 (71.1 %)	15 (78.9 %)	
ODS preoperatively	No	43 (67.2 %)	31 (68.9 %)	12 (63.2 %)	0.662[b]
	Yes	21 (32.8 %)	14 (31.1 %)	7 (36.8 %)	
Wexner score preoperatively	Median (IQR)	10.5 (0.00–14.2)	10.0 (0.0.14)	11.0 (68.5–14)	0.603[a]
	Mean (SD)	9.7 (6.7)	9.4 (6.8)	10.6 (6.6)	
	<11	32 (50.0 %)	23 (51.1 %)	9 (47.4 %)	0.792[b]
	11+	32 (50.0 %)	22 (48.9 %)	10 (52.6 %)	

[a] Mann-Whitney U test

[b] Mid-p test

diagnosed ODS was observed postoperatively. Altogether, the rate of ODS was significantly decreased ($p=0.001$). The mean and median preoperative Wexner scores were 9.7 ± 6.7 and 10.5 (IQR 0 to 14.25). Postoperatively, the Wexner score significantly decreased to a mean of 4.4 ± 4.7 and a median of 3.0 (IQR 0 to 9.0) ($p<0.001$). There were no significant differences observed between patients with and without a recurrence in the later course of the follow-up concerning the incidence of postoperative incontinence, Wexner score and postoperative ODS (Table 3).

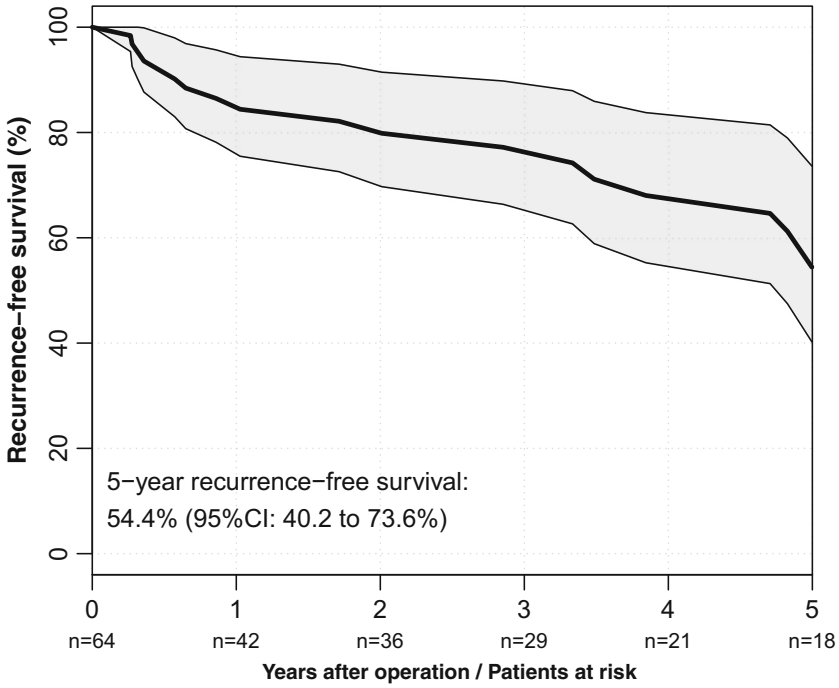

Fig. 2 Five-year recurrence-free survival after PSP. Kaplan-Meier curve for the 5-year recurrence-free survival after PSP with point-wise 95 % confidence intervals. Also shown is the number of patients at risk for each year. Patients were censored 5 years postoperatively

Incontinence, Wexner score and subjective outcomes at follow-up

Table 4 summarizes the data found at follow-up, which was limited to 42 patients who were alive at the time of follow-up. Overall, patients were quite satisfied with the procedure with a median of 8.0 (IQR 6.2 to 9.0) out of ten possible points. Furthermore, the majority of the patients would redo the procedure under the same circumstances (median 8.0 of 10 (IQR 6.0 to 10.0)). Patient's satisfaction with the operation and the re-election of this type of operation was significantly higher in patients who did not suffer from a recurrence. QoL on the four scales of the FIQL was significantly higher in patients that did not experience a recurrent prolapse. In patients with recurrence compared to those without, only a tendency for higher rates of incontinence and higher Wexner

Table 2 Prognostic factors for recurrence

		Unadjusted[a]		Cox regression, full model[b]		Cox regression, variable selection[c]	
		HR (95 % CI)	p^d	HR (95 % CI)	p^d	HR (95 % CI)	p^d
Age	<80 years	Reference	0.021	Reference	0.094	Reference	0.136
	80+ years	0.30 (0.10–0.92)		0.38 (0.12–1.26)		0.44 (0.14–1.39)	
BMI	(kg/m^2)	1.03 (0.93–1.15)	0.578	1.06 (0.94–1.18)	0.348	–	–
Anaesthesia	General	Reference	0.566	Reference	0.404	–	–
	Spinal	1.32 (0.50–3.49)		0.59 (0.18–2.01)		–	
Prolapse	Primary	Reference	0.048	Reference	0.005	Reference	0.016
	Recurrent	2.72 (1.07–6.95)		5.85 (1.68–20.35)		3.79 (1.35–10.63)	
Specimen length	<8 cm	Reference	0.109	Reference	0.039	Reference	0.044
	>8 cm	0.47 (0.18–1.21)		0.26 (0.07–0.98)		0.25 (0.06 – 1.01)	
ODS	No	Reference	0.258	Reference	0.071	Reference	0.022
preoperatively	Yes	1.75 (0.68–4.48)		4.23 (0.82–21.71)		5.65 (1.24–25.72)	

Hazard ratios (HR) with 95 % confidence intervals (Wald type)

[a] Univariable Cox regression analysis

[b] Cox regression analysis full model

[c] Backward variable selection from full model Cox regression

[d] Likelihood ratio tests

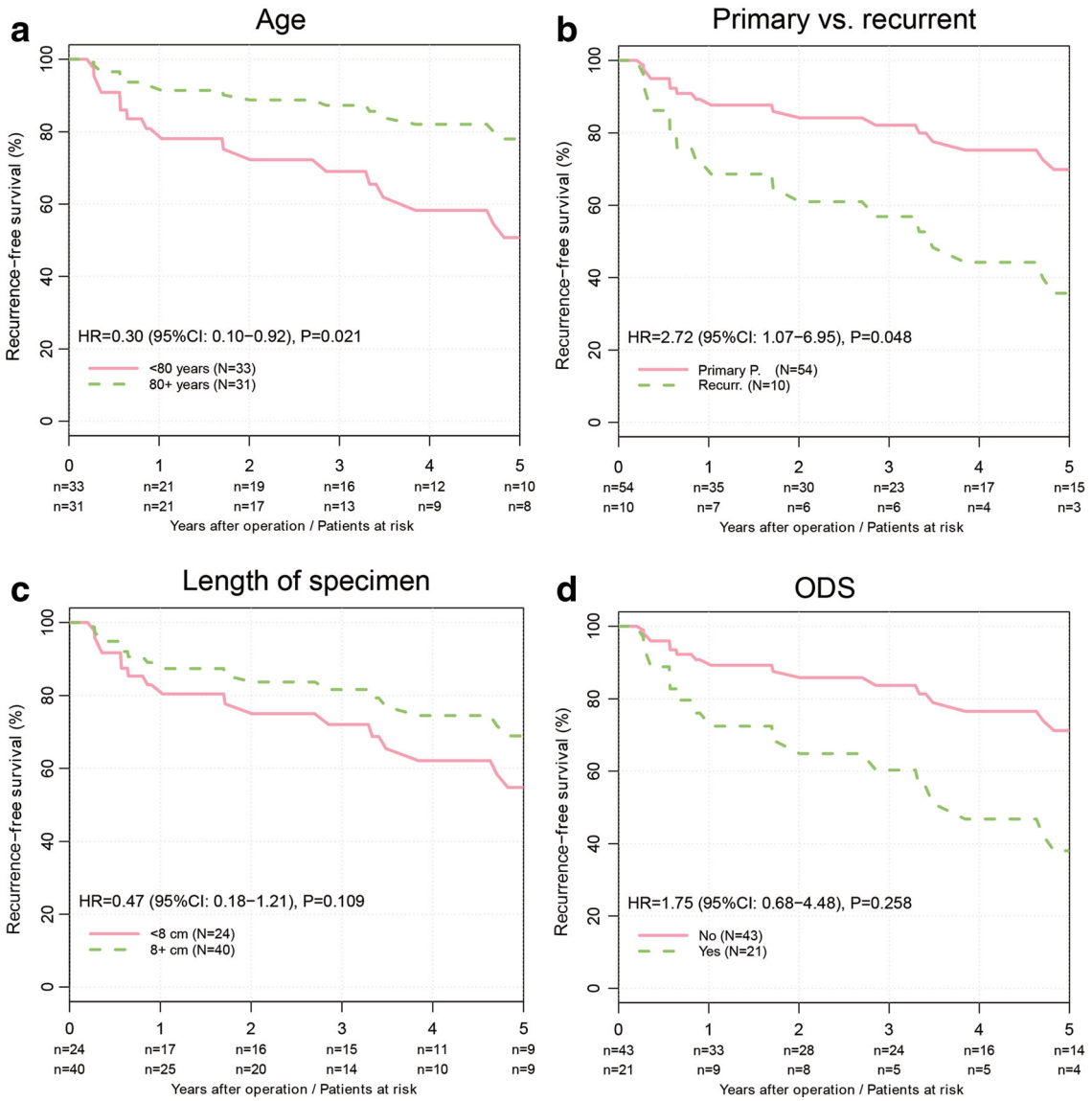

Fig. 3 Five-year recurrence-free survival after PSP according to age, ODS, length of specimen, and pre-existing recurrent prolapse. This figure displays the Kaplan-Meier curves according to age (**a**), primary vs. recurrent prolapse (**b**), length of the pathological specimen (**c**), and preoperative ODS (**d**). Also depicted are the hazard ratios and P values in the univariable Cox regression and the number of patients at risk

scores was observed. Figure 4 shows that continence measured with the Wexner score did not deteriorate with increasing duration of the follow-up.

Auxiliary analysis

The complete analysis was repeated as a per-protocol analysis excluding the two patients who did not undergo PSP as planned. This analysis fully confirmed the previous results.

The 5-year recurrence-free survival rate was estimated at 53.7 % (95 % CI 39.5 % to 73.1 %). In multivariable Cox regression, previous recurrent prolapse (HR = 3.58, 95 % CI 1.27 to 10.1, $p = 0.021$) and preoperative ODS (HR = 5.37, 95 % CI 1.20–24.16, $p = 0.025$) increased the risk of a recurrence, and a pathologic specimen longer than 8 cm decreased the risk (HR = 0.25, 95 % CI 0.06 to 0.99, $p = 0.040$). Patients aged over 80 years tended to have a decreased risk for recurrence (HR = 0.43, 95 % CI 0.14 to 1.36, $p = 0.127$). Major complications (≥ Dindo III) occurred in none of the patients, in which PSP was completed.

Discussion

The main findings of this analysis of long-term results after PSP were threefold. Firstly, PSP is an easily feasible and safe procedure for complete rectal prolapse in a collective of very old, frail patients at the price of a rather high 5-year recurrence rate of 45.6 %. Secondly, previous recurrent prolapse, a preoperative ODS and a specimen shorter than 8 cm are risk

Table 3 Postoperative incontinence, Wexner score and ODS

		Total ($N=64$)	No recurrence ($N=45$)	Recurrence ($N=19$)	p value
Incontinence postoperatively	No	29 (45.3 %)	17 (37.8 %)	12 (63.2 %)	0.072[a]
	Yes	35 (54.7 %)	28 (62.2 %)	7 (36.8 %)	
	Temporary	9 (14.1 %)	9 (20.0 %)	0 (0.0 %)	0.036[b]
	Declining	6 (9.4 %)	6 (13.3 %)	0 (0.0 %)	
	Permanent	20 (31.2 %)	13 (28.9 %)	7 (36.8 %)	
ODS postoperatively	No	57 (89.1 %)	40 (88.9 %)	17 (89.5 %)	0.981[a]
	Yes	7 (10.9 %)	5 (11.1 %)	2 (10.5 %)	
Wexner score postoperatively	Median (IQR)	3.0 (0.0–9.0)	5.0 (0.0–9.0)	0.0 (0.0–8.0)	0.218[c]
	Mean (SD)	4.4 (4.7)	4.8 (4.5)	3.4 (5.2)	

[a] Mid-p test

[b] Monte Carlo simulated chi-square test

[c] Mann-Whitney U test

factors for recurrence. And thirdly, functional outcome and satisfaction remain high in the long term.

Information on outcome of the PSP procedure is still sparse. Only a very small case series of nine patients was published so far assessing long-term results, including the learning curve of the operating surgeons. Our results compare somewhat favourably to the similar recurrence rate of 44 % at a median follow-up of 40 months. This is because recurrence was reported after a shorter time period, and the surgeons probably only operated on primary prolapses [12]. As only data of about 120 patients undergoing PSP exist in the literature, the presented 64 PSPs represent the largest cohort

Table 4 Outcomes at follow-up

		Total ($N=42$)	No recurrence ($N=24$)	Recurrence ($N=18$)	p value
Medication	No	16 (38.1 %)	9 (37.5 %)	7 (38.9 %)	0.672[a]
	Congesting	16 (38.1 %)	8 (33.3 %)	8 (44.4 %)	
	Laxatives	10 (23.8 %)	7 (29.2 %)	3 (16.7 %)	
Abdominal problems	No	38 (90.5 %)	21 (87.5 %)	17 (94.4 %)	0.515[b]
	Yes	4 (9.5 %)	3 (12.5 %)	1 (5.6 %)	
Incontinence	No	18 (42.9 %)	13 (54.2 %)	5 (27.8 %)	0.101[b]
	Yes	24 (57.1 %)	11 (45.8 %)	13 (72.2 %)	
Wexner score at follow-up	Median (IQR)	6.5 (2.0–9.0)	5.0 (1.5–9.0)	7.5 (3.8–9.0)	0.315[c]
	Mean (SD)	6.1 (4.4)	5.8 (5.1)	6.6 (3.3)	
Likert scales (0 to 10)					
Satisfaction with operation	Median (IQR)	8.0 (6.2–9.0)	8.5 (7.0–10.0)	7.0 (6.0–8.8)	0.038[c]
	Mean (SD)	7.7 (1.9)	8.3 (1.7)	7.0 (2.1)	
Re-election of operation	Median (IQR)	8.0 (6.0–10.0)	9.0 (8.0–10.0)	6.0 (5.0–8.0)	0.001[c]
	Mean (SD)	7.7 (2.1)	8.7 (1.5)	6.4 (2.0)	
General quality of life	Median (IQR)	8.0 (7.2–9.0)	8.0 (7.0–9.0)	8.0 (8.0–9.0)	0.886[c]
	Mean (SD)	8.1 (1.5)	8.1 (1.6)	8.1 (1.4)	
FIQL scores					
Lifestyle	Median (IQR)	3.3 (3.2–3.5)	3.5 (3.3–3.6)	3.2 (3.1–3.3)	<0.001[c]
	Mean (SD)	3.3 (0.3)	3.5 (0.3)	3.2 (0.3)	
Coping	Median (IQR)	3.1 (2.9–3.2)	3.2 (3.1–3.3)	2.9 (2.8–3.0)	<0.001[c]
	Mean (SD)	3.1 (0.4)	3.2 (0.4)	2.9 (0.2)	
Depression	Median (IQR)	3.6 (3.5–3.7)	3.6 (3.6–3.7)	3.5 (3.5–3.6)	<0.001[c]
	Mean (SD)	3.6 (0.2)	3.6 (0.2)	3.5 (0.1)	
Embarrassment	Median (IQR)	3.4 (3.3–3.6)	3.6 (3.4–3.7)	3.3 (3.2–3.3)	<0.001[c]
	Mean (SD)	3.4 (0.3)	3.6 (0.3)	3.2 (0.3)	

[a] Monte Carlo simulated chi-square test

[b] Mid-p test

[c] Mann-Whitney U test

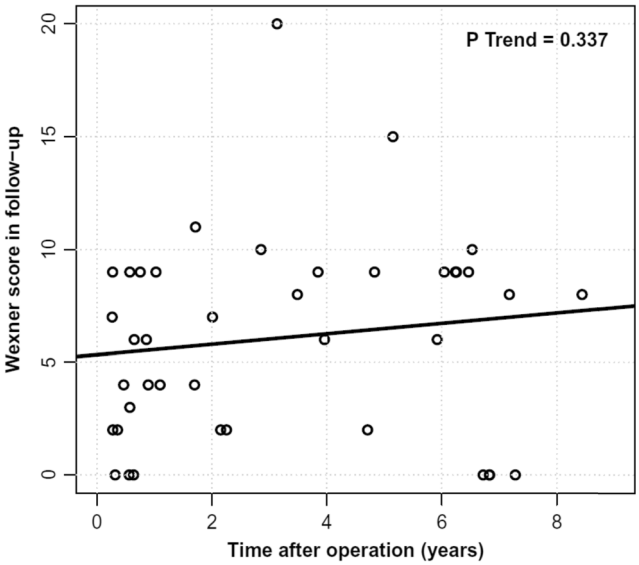

Fig. 4 Wexner score at follow-up over time

reported on [2, 10–13, 17, 24, 25]. It has to be stated that some of the patients were already part of earlier analyses, which assessed feasibility, early and midterm results [2, 11, 13]. This is a completely new analysis, done more than 3.5 years after the last one, which makes analyzing long-term results possible. Furthermore, a multivariate analysis and a propensity score analysis were performed to assess risk factors for recurrence, which had not been done before.

Recurrence rate in comparison with other procedures

In order to explain the somewhat elevated recurrence rate, it must be taken into account that both patients with primary and with recurrent prolapse were included in the analysis. On a standalone basis, patients with the operation of a primary complete rectal prolapse had a recurrence rate of 29.9 % at 5 years. This is similar to the recurrence rate of 31 % for Rehn-Delorme's procedure and of 24 % for Altemeier's rectosigmoidectomy at 3 years after primary prolapses, as found in the PROSPER trial [8]. Most case series with lower recurrence rates after other perineal procedures either have a shorter follow-up time or are in combination with an additional levatorplasty, or both [26, 27]. At 2 years, the recurrence rate in our patients is also remarkably lower with 19.9 % including the operations on previous recurrent prolapse. So, recurrence after PSP seems similar to Altemeier's and is probably slightly lower than Rehn-Delorme's, if levatorplasty is not added. Levatorplasty could also be added to PSP, but it would probably make the easy procedure more complex and more prone to complications. This is shown by Chun et al., with the complication rate of 21.7 % including several serious complications and a mean operation time of 97.6 min for Altemeier's with levatorplasty [28]. The recurrence rate after procedures with an abdominal approach seems to be lower [29] but to come at the cost of more and severer complications [30]. Perhaps, the latter becomes less pronounced as a consequence of wider usage of laparoscopy and D'Hoore's ventral rectopexy, as newer reviews propose [31, 32]. Though, a reoperation rate of 4.8 % still seems rather high [32].

However, up to this date, there is not enough evidence to make a clear scientific statement as to which procedure is superior in regard to recurrence rate. It is not even evident whether a perineal or a laparoscopic approach is better [4, 33]. Furthermore, evidence on recurrence rate in the long term after perineal procedures is very low; e.g. in the PROSPER trial, only 15 patients in each group were available for follow-up after 5 years [8].

Prognostic factors for development of recurrence

The pathological mechanism for development of a recurrent rectal prolapse is still not known. What seems to be clear is that patients suffering from a recurrent prolapse are at a higher risk to develop a recurrence after operative treatment of the prolapse [34]. So, it is not astonishing that patients undergoing PSP show less recurrence if they suffer from a primary prolapse. All the same, a 5-year recurrence-free survival of only 34.3 % is astonishingly low compared to up to 50 % reported in a recent systematic review of other procedures [34]. It remains unclear whether the elevated recurrence rate is only caused by the relatively long time at risk (5 years) or whether PSP is inferior to other procedures in the treatment of recurrent prolapse.

That patients with a resected specimen length of more than 8 cm develop less recurrences is surprising. Until now, it was thought that a longer prolapse would give more recurrences [11]. A possible reason for this opposed result could be that the resection of the prolapse was more complete in patients with a longer specimen. The diminished recurrence rate in patients without preoperative ODS and in older patients might be caused by the fact that these patients strain less during defecation. Although conclusive studies on the issue are lacking, more pronounced straining is currently considered to be a risk factor for recurrence [34, 35]. Even if it is probable that patients having problems to evacuate are at higher risk to suffer from a recurrence after PSP than after abdominal procedures, this cannot be concluded from the literature so far.

Morbidity, functional outcome and satisfaction, QoL

In the intention-to-treat analysis, we found only one major complication in the patient converted to Altemeier's rectosigmoidectomy. None of the patients who successfully underwent a PSP had to be reoperated. Therefore, PSP can be seen as a safe procedure. The low complication rate of 15.6 % minor complications and the lack of mortality seem all the better in view of the very old and frail patients treated

with an age up to 97 years. Earlier studies [2, 10–13, 17, 24, 25] also report the same low morbidity. The rather long median hospital stay of 6 days was not caused by post-operative morbidity, but instead mainly by additionally performed diagnostic procedures, e.g. pre-operative colonoscopies or cardiac investigations. The good feasibility and the easy-to-perform operative technique have already been reported and have intrigued former authors commenting on PSP [11, 25]. These findings are also documented in the short median operation time of 32.5 min. Altemeier's rectosigmoidectomy and Rehn-Delorme's procedure are technically more demanding, need more time and have remarkably more complications, as the 2 % mortality rate in the PROSPER trial for perineal approaches shows [8, 26, 27]. As in an earlier study [11], function in terms of incontinence and ODS improved impressively. The Wexner score decreased by more than half (9.7 to 4.4). This effect can also be observed after other perineal procedures, although to a slightly lower extent [8]. In contrast to the study of Tschuor, functional outcome was good. A new onset of incontinence in 6 of 17 continent patients is worrisome, even if they all improved spontaneously. On the other hand, this is only a deterioration of continence in 9.4 % of all patients. Similar rates up to 11 % have been observed after laparoscopic anterior rectopexy [36] and even higher ones after Rehn-Delorme's [37]. However, it comes as no surprise that satisfaction with the procedure, as well as QoL, was good after PSP, especially in those not suffering from a recurrence in the further course.

Limitations

The limitations of the study should be elucidated. A clear weakness was the observational nature of the analysis.

Furthermore, most patients were not seen at follow-up, so a recurrent prolapse or other important information could have been missed. However, a recurrent prolapse is usually noticed by the patient, his relatives or the general practitioner. Therefore, the number of missed prolapses is likely to be insignificant.

Conclusion

PSP is an easy-to-perform procedure for rectal prolapse. It is associated with a low morbidity, high patients' satisfaction and good functional outcome. It is likely to be a good alternative to the other perineal procedures such as Altemeier's or Rehn-Delorme's, which are more complex to perform. Especially in the old and frail, as operated on in our study, the somewhat elevated recurrence rate is acceptable due to the high chance that these patients do not live to see a recurrence. The indication for a PSP has to be evaluated with care in patients with a recurrent prolapse, preoperative ODS or a very small prolapse. Due to their significantly elevated recurrence rate, these patients may profit more from another operative procedure such as laparoscopic rectopexy.

Compliance with ethical standards

Conflict of interest There was no direct or indirect funding of the work presented here. L.M. and F.H. were former consultants for Ethicon for the STARR procedure. As the same stapler is used to perform PSP, this might be seen as a possible conflict of interest.

Ethical approval All procedures performed in the study presented involving human participants were performed in accordance with the current version of the Declaration of Helsinki, good clinical practice guidelines and local legislation. The study was approved by the Ethics Committee of the Canton St. Gallen.

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

Authors' contributions Study conception and design: B.H., S.B., F.H. and L.M.. Acquisition of data: B.H., S.B., R.W. and L.M.. Analysis and interpretation of data: B.H., J.H., S.B., R.W. and L.M.. Drafting of the manuscript: B.H., J.H., F.H., R.W., M.Z., W.B., B.W., B.S. and L.M.. Critical revision of manuscript: B.H., J.H., S.B., F.H., R.W., M.Z., W.B., B.W., B.S. and L.M.

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