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ORIGINAL ARTICLE

# New approach in vaginal prolapse repair: mini-invasive surgery associated with application of platelet-rich fibrin

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**Abstract**
*Introduction and hypothesis* Platelet-rich fibrin (PRF) matrix is an autologous leukocyte and PRF biomaterial. PRF is a fibrin matrix polymerized in a tetramolecular structure with the incorporation of platelets, leukocytes, cytokines, and circulating stem cells. The three-dimensional structure of PRF is optimal for migration of endothelial cells and fibroblasts. It permits rapid angiogenesis and easier remodeling of fibrin in a more resistant connective matrix. In vaginal surgery, PRF may act as a graft material with better healing and better functional outcome.
*Methods* We performed a prospective observational study on ten consecutive women requiring surgery for prolapse recurrence (stage II or higher). These women had high risks for recurrence, erosion with graft materials, and intraoperative and postoperative complications with traditional pelvic reconstructive surgical procedures. ICS score and P-QoL Questionnaire results were assessed preoperatively and postoperatively. Surgery consisted of anterior, posterior, or apical repair plus PRF. Follow-up was performed at 1, 6, 12, 18, and 24 months.
*Results* Anatomically, the success rate was 80%. Prolapse symptoms improved by 100%. Sexual activity increased by 20% without dyspareunia. The surgical time was satisfactory (mean, 38.5 min). There were no intraoperative or postoperative complications.
*Conclusions* The use of PRF for site-specific prolapse repair is associated with a good functional outcome because of the healing and mechanical properties of PRF.

**Keywords** Dyspareunia · Pelvic organ prolapse (POP) · Platelet-rich fibrin (PRF) · Quality of life · Recurrence · Site-specific repair

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## Introduction

Over the years, several surgical procedures have been described to correct pelvic organ prolapse (POP). Despite improvement in the knowledge of pelvic anatomy and advances in surgical techniques, the success rates of traditional pelvic reconstructive surgical procedures are variable and sometimes disappointing with an overall recurrence rate of 30% [1–3].

There is significant risk of reoperation after pelvic reconstructive surgery. The need to improve the outcome of traditional surgical treatment has led to increased use of graft materials in pelvic reconstructive surgery [3]. Although the success rate with synthetic materials is good, the risk of vaginal extrusion and exposure is considerable at 10.7% to 12.27% [4, 5].

Inflammatory phases are necessary for the desired fibrosis to occur, but this inflammation may lead to adverse effects such as implant shrinkage, erosion, adhesion formation [6–8], wound granulation, and dyspareunia [5]. In fact, after mesh implantation, the host immediately reacts to the

injury, and the material becomes covered with a biofilm. Host proteins are absorbed at the interface, and a complex host-to-implant material interaction begins [7]. Proteins later undergo conformational changes, making them immunogenic. As the biofilm becomes immunogenic, it triggers a typical inflammatory response, including activation of the complement system, binding of antibodies, leukocyte formation, blood clotting, and fibrinolysis activation. A chronic inflammatory reaction follows, ultimately transitioning into a foreign body reaction. The granulation tissue contains fibroblasts and macrophages and undergoes neovascularization. Macrophages are the crucial cell type in the ultimate clinical response of either biotolerance or rejection of the foreign body [8].

Among the great challenges facing clinical research is the development of bioactive surgical additives that regulate inflammation and increase healing. Although the use of fibrin adhesives in many field-related protocols has been well documented during the past 30 years [9, 10], it remains controversial because of the complexity of production protocols (for autologous adhesives) and risk of cross-infection (for commercial adhesives).

A new platelet concentrate, which is neither a fibrin glue nor a classical platelet concentrate, was tested for the first time in France by Choukroun et al. and introduced with the European Directive 2004/23/CE of March 31, 2004. This new biomaterial, called platelet-rich fibrin (PRF), looks like an autologous cicatricial matrix. PRF is a strictly autologous fibrin matrix containing a large quantity of platelet and leukocyte cytokines. The PRF production protocol attempts to accumulate platelets and release cytokines in a fibrin clot. The platelet granules are a reservoir of many growth factors (GFs) that are known to play a crucial role in hard and soft tissue repair mechanisms [11–13]. The fibrin matrix ensures a slow release of GFs (e.g., TGF-β1, PDGF, VEGF, FGF-2, etc.) over time and effectively protects the GFs against proteolytic degradation. Moreover, PRF slowly releases cytokines by increasing degranulation of leukocytes and platelets that are trapped in the fibrin network. The cytokines are able to regulate the inflammatory reaction. IL-1b, IL-4, IL-6, VEGF, and TNF-α together constitute a key link in inflammatory regulation: They inhibit the inflammatory signal pathway by neutralizing its amplification; in addition, they support and coordinate the development of initial cicatricial structures. Thus, PRF is not only a platelet concentrate but also an immune node that is able to stimulate defense mechanisms [14].

PRF was first developed for specific use in oral and maxillofacial surgery and tissue healing [15–17]. This technique requires neither anticoagulant nor bovine thrombin (nor any other gelling agent), making it no more than centrifuged natural blood without additives. It can be used directly as a clot or after compression as a strong membrane.

Although PRF belongs to a new generation of platelet concentrates, it is primarily a fibrin technology. Indeed, the biological activity of the fibrin molecule is enough in itself to account for the significant cicatricial capacity of the PRF. The three-dimensional structure of PRF is optimal for migration of endothelial cells and fibroblasts. It permits rapid angiogenesis and easier remodeling of fibrin in a more resistant connective matrix [16].

The slow polymerization mode of PRF conforms its membrane into a particularly favorable physiologic architecture to support the healing process. PRF has the characteristic of polymerizing naturally and slowly during centrifugation, and the thrombin concentrations acting on the collected autologous fibrinogen are almost physiologic. This aspect is crucial in determining the three-dimensional organization of a fibrin network. The PRF membrane is flexible, elastic, and very strong. Moreover, this biomaterial would be a favorable matrix for the development of coherent healing without an excessive inflammatory response [14], as is the case using mesh.

We hypothesized that PRF in vaginal surgery is a biomaterial comparable with mesh. Moreover, the functional result of PRF in the surgical site is better in terms of healing and immunological properties.

## Materials and methods

The Vivostat system (Vivostat A/S, Denmark) (Fig. 1) is an automated system for the on-site preparation and application


**Fig. 1** Vivostat system

of PRF. It incorporates a unique and patented biochemical process that produces an autologous sealant (6 ml) from 120 ml of the patient's own blood in 23 min. The system comprises three components: a Processor Unit for the preparation of PRF, an Applicator Unit to control the delivery of PRF, and a disposable kit comprising all components required to collect blood and apply the sealant to the surgical site.

The polymerization of Vivostat fibrin is activated by a simple pH change and does not require an enzymatic reaction. Activation of the coagulation cascade initiates cross-linking of the fibrin polymer and obtains 80% of its full strength within only 1 min with strong adhesion to tissue. Vivostat fibrin moves with the tissue and is extremely flexible without compromising strength. A high level of elasticity is particularly important for surgical procedures involving tissue that undergoes continual expansion or contraction [18–20].

The fibrin concentration in the Vivostat end product is independent of both the source and the plasma fibrinogen level. The Vivostat Processor Unit is designed with specially developed sensors and software that carefully detect the individual patient's fibrinogen level and automatically adjust the amount of diluting buffer to extract a fibrin sealant with a constant concentration of fibrinogen (17 mg/ml of fibrin).

Vivostat PRF delivers a concentrate of GFs embedded in a fibrin matrix. Following application of the Vivostat PRF solution, the fibrin matrix is broken down by a fibrinolytic process (fibrinolysis) as part of the natural healing process. During this process, the GFs contained in the platelets are gradually released into the wound over a period of 4 days. The autologous fibrin matrix in Vivostat PRF protects endogenous GFs against proteolytic degradation and thereby preserves their biological activity.

The design of both the Applicator Unit and the Vivostat Spraypen (Fig. 2) provides the surgeon with up to 7 min of constant spraying of 6 ml of Vivostat PRF. The Vivostat Spraypen gives the surgeon freedom to place the solution very accurately onto the target site instead of the surrounding tissue.

Surgical procedures were performed under epidural anesthesia using site-specific repair. The PRF was sprayed directly onto the surgical site, where it polymerized on contact. The technology of the Spraypen enables the PRF solution to polymerize immediately upon application. When the PRF polymerizes, it turns into a white "gel" that is visible to the eye, which helps the surgeon to see where the solution has been applied. PRF obtains 80% of its full strength within only 1 min with strong adhesion to tissue. The Spraypen can be used intermittently during the entire surgical procedure. It enables accurate placement of the solution where it is needed. The PRF can be applied at a very close range, allowing for pinpoint application and rapid polymerization, ensuring that the fibrin remains where it is applied. In our practice, about 1 ml of PRF solution can cover an area of 3 to 4 cm. When the injection is in a visible area, we stop the application when a white membrane appears. When we perform blind injection, we stop the procedure when bubbles appear; this indicates that the detachment is filled with PRF.

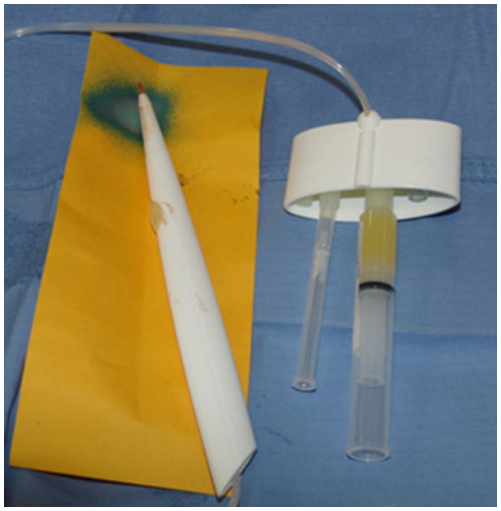

**Fig. 2** Vivostat Spraypen

Anterior repair was performed for transverse and midline defects using a continuous 2-0 delayed absorbable suture (polyglycolic Safil) with minimal tension plus PRF. Partial or complete detachment of the pubocervical fascia from the arcus tendineus was repaired with application of PRF.

Posterior repair was performed using a continuous 2-0 delayed absorbable suture with minimal tension plus PRF after any posterior defects were identified. The rectovaginal fascia was reattached to the perineal body with interrupted absorbable suture.

Perineorrhaphy was not routinely performed, but was included when necessary to decrease the size of the genital hiatus and to reconstruct the perineal body in women who had separation of the superficial transverse perineal muscles. The transverse perineal muscles were plicated with an interrupted suture. A small amount of vaginal epithelium was trimmed if deemed appropriate. The vaginal mucosa was closed with a continuous 2-0 delayed absorbable suture and an interrupted suture to the perineum. All passages were accomplished with PRF.

Apical repair was performed by the use of PRF plus attachment of the vaginal cuff and the anterior vaginal wall muscularis to the uterosacral ligaments. Deep pelvic dissection was not necessary; in fact, the PRF was blindly injected as closely as possible to the arcus tendineus because the tip of the Spraypen can be directly apposed near the defect. In

addition, the PRF adhesive properties of PRF fibrin and its platelet and GH content reduce the risk of bleeding during and after the surgery.

Enterocele repair was performed together with PRF. For women with occult stress urinary incontinence, plication of the endopelvic fascia at the level of the midportion of the urethra was performed with two interrupted 2-0 delayed absorbable sutures plus PRF.

During surgery, 3-g sulbactam/ampicillin was administered intravenously. One-day antibiotic prophylaxis was prescribed. For anterior repair, an indwelling Foley catheter for bladder drainage was placed for the first 72 h. For posterior repair, an indwelling Foley catheter was placed for the first 24 h. After catheter removal, all patients had spontaneous voiding, with a residual of <100 ml.

The postoperative regimen included minimization of all activity for 2 weeks, no sexual activity for 6 weeks, and no athletic activity or lifting of weights greater than 10 kg for 3 months.

Between April 2008 and April 2011, 60 patients underwent vaginal repair with PRF. We experienced the longest follow-up (28.4 months; range, 24–37) for ten of these women recruited from April 1, 2008, to May 31, 2009. All women had symptomatic recurrence of genital prolapse. We carried out this preliminary prospective observational study because, in these women, there was no evidence for the best treatment with traditional pelvic reconstructive surgical procedures. The inclusion criteria were: POP of stage II or higher, high risk for recurrence, high risk for erosion with graft materials, and high risk for intraoperative and postoperative complications with traditional pelvic reconstructive surgical procedures (anesthetic and bleeding risks). Each woman had more than one risk factor for recurrence, erosion, or postoperative complications as follows: previous prolapse surgery in all patients, obesity (body mass index [BMI] of >29) in four patients, chronic bronchopneumonia in one, chronic straining with defecation in three, history of hernia or collagen disease in three, history of smoking in four, diabetes in three, immunodepression in three, hypertension in two, dysthyroidism in three, previous safenectomy in three, and postoperative hematoma during a previous vaginal surgery in one (Table 1).

All patients had previous vaginal hysterectomy and concomitant pelvic reconstructive surgery for prolapse without any graft materials. The mean elapsed time from previous gynecological surgery was 9.9 years (range, 2–22 years). The mean time of recurrence was 4.8 years (range, 1–16 years). The mean age was 62.7 years (range, 55–71 years), mean BMI was 27 (range, 21–35), and mean vaginal parity was 1.8 pregnancies (range, 1–3 pregnancies). All patients were postmenopausal for a mean of 13.3 years (range, 4–23 years). The mean presurgical hemoglobin concentration was 13.73 (range, 12.4–14.9) (Table 1).

**Table 1** Patient demographic and clinical data

| | | |
|---|---|---|
| Age | Mean 62.7 years | (Range 55–71) |
| BMI | Mean 27 kg/m$^2$ | (Range 21–35) |
| Parity | Mean 1.8 pregnancies | (Range 1–3) |
| Postmenopausal | Mean 13.3 years | (Range 4–23) |
| Presurgical hemoglobin concentrations | Mean 13.73 | (Range 12.4–14.9) |
| History of hernia or collagen disease | 3/10 | 30% |
| Immunodepression | 3/10 | 30% |
| Safenectomy | 3/10 | 30% |
| Smoking history | 4/10 | 40% |
| Hypertension | 2/10 | 20% |
| Diabetic | 3/10 | 30% |
| Dysthyroidism | 3/10 | 30% |
| Postoperative hematoma in previous vaginal surgery | 1/10 | 10% |
| Sexually active | 6/10 | 60% |
| Chronic straining at defecation | 3/10 | 30% |
| Chronic bronchopneumonia | 1/10 | 10% |
| Obesity | 4/10 | 40% |

The patients had a combination of pelvic defects. Six patients (60%) had stage III: three had stage IIIa, and three had stage IIIp. All of these patients had concomitant stage IIc, and enterocele was also present in five. In the three patients with stage IIIa, two had stage Ip, and one had stage IIp. All three patients with stage IIIp also had stage Ia. SUI was present in one patient (IIIa/IIc/Ip).

Four patients (40%) had stage II: one had stage IIa, and three had stage IIp. The patient with stage IIa had also stage Ic and Ip, SUI, and perineal body deficiency. All three patients with stage IIp had concomitant stage Ic and Ip (Table 2).

The three patients with stage IIIa underwent anterior repair, enterocele repair, apical repair, and perineal body repair. The transverse perineal muscles were plicated in two patients (transverse low), and one of these patients (GH 5, PB 1) also underwent reductive plastic surgery. The patient with SUI underwent plication of the endopelvic fascia at the level of the midportion of the urethra (IIIa, IIc, and Ib). The patient with stage IIa and SUI underwent plication of the endopelvic fascia at the level of the midportion of the urethra, anterior repair, and perineal body repair. The three patients with stage IIIp underwent apical repair (enterocele repair in two), posterior repair, perineal body repair, and transverse perineal muscle plication. Anterior repair was not performed in any of these patients. We believe that adequate posterior and vaginal vault prolapse repair can also improve low anterior (Ba I) defects. Moreover, the three patients with stage IIp did not undergo anterior

**Table 2** Preoperative measurements of each patient according to the ICS pelvic organ prolapse grading system

| Pts | Stage | Aa | Ba | C | GH | PB | TVL | Ap | Bp | * or ° |
|---|---|---|---|---|---|---|---|---|---|---|
| 1 | IIIa/IIc/Ip | 0 | +4 | −2 | 3.5 | 2 | 9 | −2 | −2 | * and ° |
| 2 | IIIa/IIc/Ip | −1 | +3 | −1 | 3 | 2 | 9 | −3 | −2 | * |
| 3 | Ia/Ic/IIp | −3 | −2 | −6 | 4.5 | 1 | 9 | +1 | 0 | |
| 4 | Ia/Ic/IIp | −3 | −2 | −6 | 3 | 3 | 10 | −2 | +1 | |
| 5 | Ia/IIc/IIIp | −3 | −2 | −3 | 3 | 1 | 10 | +3 | +2 | |
| 6 | Ia/IIc/IIIp | −3 | −2 | −2 | 3.5 | 2 | 9 | −2 | +4 | * |
| 7 | Ia/IIc/IIIp | −3 | −2 | −3 | 3.5 | 2 | 10 | −1 | +3 | * |
| 8 | Ia/Ic/IIp | −3 | −2 | −6 | 3 | 2 | 9 | −1 | 0 | |
| 9 | IIa/Ic/Ip | 0 | 0 | −6 | 3 | 2 | 10 | −2 | −2 | ° |
| 10 | IIIa/IIc/IIp | −1 | +3 | −2 | 5 | 2 | 9 | 0 | 0 | * |

*Aa* and *Ba* anterior wall ICS pelvic organ prolapse grading system, *Ap* and *Bp* posterior wall ICS pelvic organ prolapse grading system, *C* cuff

*Enterocele

°Occult stress incontinence

repair, but instead underwent apical repair, posterior repair, and perineal body repair. One patient (GH 4.5, PB 1) underwent transverse perineal muscle plication and reductive plastic surgery.

All patients went through a routine informed consent process during which surgical options were discussed. Approval for this study was granted by the local Human Institutional Investigation Committee. All patients were informed about the research aim and procedures and gave their informed consent.

Each woman was evaluated with the Italian version of the P-QoL (Version 4) Questionnaire [21] for lower urinary tract, bowel, sexual, and prolapse symptoms and quality of life. The severity of pelvic organ descent was assessed using the ICS pelvic organ prolapse score preoperatively and postoperatively. Each woman was reassessed 1 month postoperatively to evaluate wound healing and immediate surgical complications such as hematoma or infection. Each woman was evaluated again at 6, 12, 18, and 24 months postoperatively using the same preoperative criteria and instruments. Scar quality was assessed at 6, 12, 18, and 24 months.

Wound healing and scar quality were assessed with the Vancouver Scar Scale [22] for pigmentation, pliability, height, and vascularity. We expressed our degree of satisfaction about the cicatricial results of the surgical procedure according to a four-point scale. A total numerical value was then calculated depending on the scar quality: 0 = poor, 1 = fairly good, 2 = good, and 3 = very good.

Prolapse repair was considered to be anatomically successful if the patient was asymptomatic and classified as stage 0 according to the ICS POP system.

## Results

Table 3 shows the preoperative and 24-month postoperative measurements for vaginal wall descent according to the ICS POP grading system.

The overall efficacy rate in terms of anatomical reconstruction was 80% for stage 0 and 20% for stage I (one patient with stage Ia and one patient with stage Ib).

Data on intraoperative and postoperative morbidity, length of hospital stay, time to spontaneous voiding, and canalization were collected. Intraoperative and early postoperative data are shown in Table 4.

Table 5 shows the preoperative and postoperative characteristics of each woman for urinary symptoms, bowel function, sexual activity, dyspareunia, hematoma, infection, and wound healing after 1 month.

Table 6 shows the preoperative and postoperative characteristics of these women for urinary symptoms, bowel function, sexual activity, dyspareunia, and scar quality at 6, 12, 18, and 24 months.

Surgical bleeding was minimal (mean, 0.3 g/dl). When vaginal wall descent was repaired, sexual activity increased by 20%, and no women had dyspareunia after surgery. Urinary and bowel symptoms (urgency, urgency incontinence, feeling of incomplete bladder emptying, or incomplete bowel evacuation and constipation) had improved by 100% at 24 months. On follow-up, all patients had a normal scar with supple pliability. The height of the scar was either flat or at least <1 mm. No patients developed keloids. No patient reported pruritus or any type of pain in the surgical regions. No patients developed wound infections. Our degree of satisfaction with the cicatricial results was high. The amount of PRF was sufficient for all procedures and for each surgery.

## Discussion

We confirmed the efficacy of prolapse repair when PRF is used. This is particularly true when we consider our inclusion of women with supposed risk factors for prolapse relapse: previous prolapse surgery [2], obesity (BMI of >29), chronic bronchopneumonia, chronic straining with defecation, history of hernia, or collagen disease [23–27].

**Table 3** Preoperative and 24-month postoperative POP-Q measurements

| | Point Ba | | Point C | | Point Bp | |
|---|---|---|---|---|---|---|
| | Preop *n* (%) | Postop *n* (%) | Preop *n* (%) | Postop *n* (%) | Preop *n* (%) | Postop *n* (%) |
| Stage 0 | 0 | 9 (90) | 0 | 10 (100) | 0 | 9 (90) |
| Stage I | 6 (60) | 1 (10) | 4 (40) | 0 | 3 (30) | 1 (10) |
| Stage II | 1 (10) | 0 | 6 (60) | 0 | 4 (40) | 0 |
| Stage III | 3 (30) | 0 | 0 | 0 | 3 (30) | 0 |
| Stage IV | 0 | 0 | 0 | 0 | 0 | 0 |

There is a low risk of intraoperative complications, such as bladder or bowel perforation, laceration of vessels, nerve injury, or hemorrhage [28]. Indeed, the lack of extensive deep pelvic dissection allows for avoidance of injury, and PRF allows for hemostasis. Paravaginal defects are identified without excessive iatrogenic dissection because the Spraypen allows the PRF to be placed at the site of the defect. Central and transverse defects are repaired using a continuous delayed absorbable suture with minimal tension. Any iatrogenic defects or surgical laxity in the fascial connections can be repaired or reinforced with PRF. Any small defect is repaired, and the surgical time is satisfactory (mean, 38.5 min; range, 20–65 min).

We believe that PRF reinforces any weak fascial support and any laxity at the level of the arcus tendineus. The minimal tension associated with the use of a continuous suture and the application of PRF allows for avoidance of recurrence. Excessive tension can create an iatrogenic defect or extend a preexisting defect. We stress the need to identify and repair each specific defect to achieve effective surgical correction.

In terms of an individual woman's quality of life, subjective outcomes are certainly more important than objective anatomic failure. Surgery will be required to correct symptoms of prolapse; restore anatomy; retain or restore bladder, bowel, and sexual function; and ensure durability.

A dyspareunia rate of up to 38% with vaginally introduced mesh for POP repair has been reported [3], and traditional posterior colporrhaphy has been cited as a cause of dyspareunia [5, 29]. We believe that the most clinically relevant finding in our study regards sexual activity. Six patients were sexually active before surgery; four of these had dyspareunia. Of the non-sexually active women, two had renounced sexual activity because of extreme difficulty during intercourse, and two had no partner or no active partner. At 24 months, eight patients with an active partner had sexual intercourse without difficulty.

**Table 4** Intraoperative and early postoperative data

| | |
|---|---|
| Operation time (min) | 38.5 min (range 20–65) |
| Hemoglobin variation after surgery[a] | 0.3 g/dl ( range 0–0.6) |
| Surgical complications | 0 |
| Hospital stay (day) | 3.3 days (range 1–4) |
| Foley catheter placement (day) | 2 days (range 1–3) |
| Canalization (day) | 2.6 days (range 1–3) |
| Fever | 0 |

[a] Postsurgical hemoglobin concentrations were measured the day after operation

Our study also showed improvement in the urinary and bowel symptoms over time. We believe that this is related to the cicatricial results of the surgical procedure because PRF ensures the maintenance of tissue elasticity over time. This is in contrast to the use of mesh, which shows good short-term but poor long-term results. Urgency was still present in five patients at 1 and 6 months, but had disappeared at 12 months. Urge incontinence was present in one patient at 1 month, but had disappeared at 6 months. A feeling of incomplete bladder emptying was present in one patient at 1 and 6 months, but had disappeared at 12 months. We believe that delayed recovery of bladder function is determined by a necessary slow rehabilitation of the bladder and urethra when the urinary symptoms associated with prolapse are present for a long period of time.

Data on bowel symptoms were collected in accordance with the International Urogynecological Association (IUGA)/International Continence Society (ICS) [30]. A feeling of incomplete bowel emptying was still present in one patient at 1 and 6 months. Constipation was present in three patients at 1 month, in two patients at 6 months, and in one patient at 1 year. Constipation was present in five patients preoperatively; three of these patients strained with defecation because of lumpy or hard stools, and two experienced slow-transit constipation with fewer than three defecations per week. These symptoms did not improve postoperatively, but these patients' subjective perceptions at 1 year indicated an improved quality of life. In fact, the sensation of anorectal obstruction or blockage, abdominal pain, and the need for manual assistance disappeared. Fecal and

**Table 5** Preoperative and postoperative characteristics of patients in terms of urinary symptoms, bowel function, sexual activity, dyspareunia, hematoma, infection, and wound healing after 1 month

| | Preoperatively | Postoperatively 1 month |
|---|---|---|
| Urgency | 7 | 5 |
| Urgency ( urinary) incontinence[a] | 3 | 1 |
| Feeling of incomplete bladder emptying | 3 | 1 |
| Sexually active | 6 | Not evaluable |
| Sexually active with dyspareunia | 4 | Not evaluable |
| Not sexually active for dyspareunia and prolapse symptoms | 2 | Not evaluable |
| Feeling of incomplete bowel evacuation | 5 | 1 |
| Fecal (flatal) urgency incontinence | 3 | 0 |
| Constipation | 5 | 3 |
| Hematoma | Not evaluable | 0 |
| Infection | Not evaluable | 0 |
| Wound healing | Not evaluable | Good |

[a]Preoperative urodynamics was performed

flatus urge incontinence showed complete improvement after surgery.

The surgical time was satisfactory, with a mean of 38.5 min (range, 20–65 min). The type of surgery (anterior and posterior or vault repair) explains the heterogeneity of the times, including longer times for vault prolapse repair.

This procedure, in contrast to mesh, is cheaper. Apart from the cost of the Processor and Applicator Unit, the disposable kit comprising all components required to collect blood and apply the sealant to the surgical site cost around 1/5 of the cost associated with mesh application.

PRF is a flexible, elastic, and very strong membrane. When PRF is sprayed on the surgical site, it polymerizes on contact and forms a strong membrane within 1 min. We can, with the Spraypen, create a membrane on the surgical site. If the defect repair is insufficient, we can apply more PRF to fill an empty space or consolidate the sutures that have been tied with minimal tension. A rectal exam is performed to ensure that there are no areas of weakness that require further PRF application and, if necessary, bladder filling. For these applications, a small amount of PRF is sufficient (1 ml covers an area of about 3–4 cm). The amount of PRF for each patient (6 ml) is sufficient for all procedures during a surgery.

PRF allows for restoration and cure of the fascial system: Platelet and leukocyte cytokines play a crucial role in hard and soft tissue repair mechanisms [15, 16]. The long-term anatomical result is satisfactory.

In summary, this study confirms that in addition to good anatomical results, the use of PRF for site-specific prolapse repair carries a good functional outcome, especially for dyspareunia. This surgical procedure takes minimal time to perform, has a low risk of intraoperative complications, results in a minor hospital stay, and is associated with a quick return to daily activities. In the long term, compared with reconstructive surgery with mesh and the classic colporrhaphy, we obtained better results because the scar was elastic, the mucous membranes were well hydrated, and patient satisfaction was high. We believe that PRF application at the time of prolapse repair should be the treatment of choice for young women and for women with any risk factors of erosion or recurrence. However, data from larger series are required to define risks and benefits associated with the addition of PRF to reconstructive pelvic surgery.

**Table 6** Preoperative and postoperative characteristics of patients in terms of urinary symptoms, bowel function, sexual activity, dyspareunia, and scar quality at 6, 12, 18, and 24 months

| | Preop | 6 months | 12 months | 18 months | 24 months |
|---|---|---|---|---|---|
| Urgency | 7 | 5 | 0 | 0 | 0 |
| Urgency (urinary) incontinence[a] | 3 | 0 | 0 | 0 | 0 |
| Feeling of incomplete bladder emptying | 3 | 1 | 0 | 0 | 0 |
| Sexually active | 6 | 5 | 8 | 8 | 8 |
| Dyspareunia | 4 | 0 | 0 | 0 | 0 |
| Feeling of incomplete bowel evacuation | 5 | 1 | 0 | 0 | 0 |
| Fecal (flatal) urgency incontinence | 3 | 0 | 0 | 0 | 0 |
| Constipation | 5 | 2 | 1 | 0 | 0 |
| Scar quality | Not evaluable | Good | Good | Good | Good |

[a]Preoperative urodynamics was performed

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**Conflicts of interest** None.

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