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CASE REPORT

Exploring robot-assisted vesicovaginal fistula repair: two case reports and a narrative literature review

Robot-assisted vesicovaginal fistula repair: case reports and literature review

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ABSTRACT

Background. Vesicovaginal fistula (VVF) is a rare occurrence in Western countries, primarily resulting from iatrogenic injuries. Surgical repair becomes necessary when

conservative management fails, However, timing and surgical approaches (vaginal, laparotomic, laparoscopic, robot-assisted) are still under debate.
Case presentation. We aim to present two case reports with a step-by-step description of the adopted robot-assisted surgical approach for the VVFs repair, highlighting its feasibility in primary and recurrent cases, along with a narrative literature review of previously described robot-assisted managed VVF cases.
Conclusions. Robot-assisted VVFs surgical repair represents a state-of-the-art treatment, combining advanced technology with surgical expertise to achieve optimal postoperative out-comes. In our experience, it is feasible, safe, effective, and represents a viable approach, especially in complex cases.
Key words
Vesicovaginal fistula; robotic surgery; minimally invasive surgery.

INTRODUCTION

Vesicovaginal fistula (VVF) is an anomalous communication between bladder and vagina, resulting in a continuous urine leakage through the vagina, accounting for approximately 1%–4% of the genitourinary fistulas (fig.1) [1]. The global incidence of the urogenital fistula is hard to define accurately. The World Health Organization (WHO) estimates that around 50000-100000 women are diagnosed worldwide with urogenital fistulae annually [2]. Causes include obstetric injury, postsurgical sequelae, radiation therapy, inflammation/infection, or trauma. In low-income countries, where perinatal obstetric care is often lacking, the most common VVF aetiology is prolonged labour. In high-income countries, VVF is primarily due to iatrogenic lesions after surgical procedures such as hysterectomy or mesh placement for urinary incontinence, with an overall incidence ranging from 0.3% to 2% [3]. VVFs can be classified as simple or complex; the former are isolated and small (≤0.5cm), whereas the latter include previously failed fistula repairs or large-sized (≥2.5 cm) fistulas. These last are often a result of chronic diseases or radiotherapy [4]. VVFs related to surgical procedures mostly occur within 7 to 10 days after surgery. However, some reports describe symptoms onset up to 6 weeks postoperatively [4]. Complementary to an accurate clinical investigation, cystoscopy and voiding cystourethrography are crucial to determine the size, number, and location of VVFs [5]. The oldest reference about VVF comes from the Kahun papyrus, ancient Egypt (2000 before Christ) [6]. VVF modern surgery dates to 1675, when Johann Fatio reported the first therapeutic success. In 1852, James Marion Sims first described a transvaginal surgical approach, whereas in 1888, Trendelenburg introduced the transabdominal approach [7]. In 1928, Martius introduced the concept of the "interposition flap" a flap of adipose tissue obtained from the labia major interposed between the bladder and vaginal sutures [8]. In 1942, Latzko described his transvaginal technique for vesicovaginal fistula repair, which remains a gold standard today. This last approach involves a partial colpoclesis, where the fistulous tract is excised, and the vaginal wall is closed in layers without direct bladder repair. It is particularly effective for supra-trigonal fistulas, ensuring high success rates while preserving bladder capacity [9]. A transabdominal technique, characterized by a wide cystotomy with dissection and excision of the fistulous tract, was described by O'Conor in 1950 [10]. Nezhat et al. were the first to publish a case report about a laparoscopic repair of VVF in 1994 [11]. The newest strategy to treat such conditions is combining a robot-assisted laparoscopic approach. The first report was published in 2005 by Melamud et al [12]. The above-mentioned technique has demonstrated high healing rates (over 95%) with excellent aesthetic results [13]. However, limited evidence about long-term prognosis is yet available. Therefore, we present two successful laparoscopic robot-assisted VVF repair cases, one in a primary and one in a recurrent case, with a long-term available outcome. Moreover, we conducted a narrative literature review on laparoscopic robot-assisted VVFs managed cases to assess the advantages and limits of such a technique.

CASE PRESENTATION

Case A

A 69-year-old Caucasian, nulliparous, obese woman was referred to the urological unit of the "SS. Annunziata" hospital in Cosenza (Italy) reporting abnormal, involuntary urinary loss on the second postoperative day after a total laparoscopic hysterectomy. Retrograde urethrocystography and voiding cystourethrography demonstrated contrast extravasation from the bladder into the vaginal cavity, consistent with a vesicovaginal fistula (Fig 2). This last was of about 1 cm in size connecting the posterior wall of the bladder with the anterior wall of the vagina, notably situated away from the bladder trigone. Three months after surgery, the patient underwent a robot-assisted laparoscopic repair of the VVF conducted by two highly experienced robotic surgeons (M.D.D. and M.M.) using the robotic platform da Vinci Xi Surgical System (Intuitive Surgical, Sunnyvale, CA, USA). Based on the appearance of vesicovaginal tissues, an extravesical approach has been chosen to repair the VVF. The first step consisted into the realization of well-defined surgical planes to effectively separate the bladder from the vagina, allowing their separate closure (Figure 3, A-C). The favourable tissue quality obviated the need for an intravesical approach, enabling operators to repair the fistula without opening the bladder. This strategy is less invasive, preserves bladder integrity, and facilitates a more efficient postoperative recovery. To minimize the risk of recurrence, the vaginal and bladder walls were sutured in a perpendicular, opposing fashion. Following adhesiolysis from prior surgeries, the Omentum was mobilized and interposed between the bladder and the vagina (fig 4 A, B). The procedure was completed with a hydrodistension bladder leak test, pelvic drain placement, and a Foley bladder catheter insertion, secured in conjunction with the ureteral stents. Console time was 115 min. The estimated blood loss was 60 cc, and no surgical-related complications were reported. The ureteral catheters were removed on the first postoperative day (POD), while abdominal drainage was removed after 48 hours. Perioperative antibiotic prophylaxis was administered for 5 days. The patient was dis-charged home on the 4th POD with an indwelling urethral catheter, which was removed after 15 days following a normal result at the voiding cystourethrography. At the 6-month and one-year follow-up assessment, the patient maintained unobstructed urinary voiding patterns, without any vesicovaginal fistula recurrence.

Case B

A 47-year-old Caucasian, multiparous woman, who had already received a laparoscopic treatment to solve a VVF occurring after total laparotomic hysterectomy with bilateral adnexectomy, was referred nine months after the repairing surgery to the Urologic Unit of the "SS. Annunziata" hospital in Cosenza (Italy), reporting recurrent abnormal, involuntary urinary loss. Retrograde urethrocystography and voiding cystourethrography demonstrated contrast extravasation into the vaginal cavity, consistent with a VVF connecting the posterior bladder wall to the anterior vaginal wall. The fistulous tract, measuring approximately 1.5 cm in size, was located very close to the ureteral orifices, an area corresponding to the intertrigonal bar. Two weeks later, the patient underwent a robot-assisted laparoscopic repair of the recurrent VVF. In this challenging case, surgeons (M.D.D and M.M) considered taking advantage of the robotic approach, aiming to overcome the technical limitations of traditional laparoscopy, namely the significant technical challenges posed by VVF dissection and intracorporeal suturing. The robotic system, with its advanced Endo-Wrist instruments, combined with a three-dimensional visualization, improved depth perception, motion scaling, tremor filtration, higher magnification, and an ergonomically favourable setup, enables procedures even in most unfavourable scenarios. Due to the proximity to the ureteral orifices, the considerable size of the fistula, and the presence of retracted tissues with dense fibrous adhesions, surgeons opted for a trans vesical approach. This strategy allowed a complete circumferential excision of the fibrous and scar tissue around the fistula while preserving both ureteral orifices. In this second case, the Omentum was short, rigid, and firmly attached to the abdominal wall. Consequently, a urachal flap, supplemented by a peritoneal leaflet, was mobilized and interposed between the bladder and vagina to effectively separate the suture lines and reduce the risk of fistula recurrence (fig 5 A-B). Also in this case, the procedure was concluded with a hydrodistension bladder leak test to confirm bladder integrity, followed by the placement of a pelvic drain and the insertion of a Foley catheter secured in conjunction with the ureteral stents. Console time was 145 min. The estimated blood loss was 80 cc, and no surgical-related complications were reported. The ureteral catheters were removed on the 1st POD, while the abdominal drainage was removed after 48 hours. Perioperative antibiotic prophylaxis was administered for 5 days. The patient was discharged home on the 4th POD with an indwelling urethral catheter, which was removed after 15 days following a normal result at the voiding cystourethrography. At the 6-month and one year follow-up assessment, the patient maintained unobstructed urinary voiding patterns, without any instances of vesicovaginal fistula recurrence detected.

4. Discussion

Vesicovaginal fistulas (VVFs) as abnormal communications between the bladder and the vagina. They carrie significant morbidity burden, including urinary incontinence, recurrent urinary tract infections, vaginal discharge, and psychological distress [7]. VVFs have a rare occurrence in Western countries, primarily resulting from iatrogenic injuries. Surgical repair becomes necessary when conservative management fails, However, timing and surgical approaches (vaginal, laparotomic, laparoscopic, robot-assisted) are still under debate. The newest strategy to treat such conditions is combining a robot-assisted to a laparoscopic approach, whom main surgical phases and key points are listed in Table 1.

The first report was published in 2005 by Melamud et al [12], where, the above-mentioned technique, has demonstrated high healing rates (over 95%) with excellent aesthetic results [13-17], however, limited evidence about long-term prognosis is yet available.

Aiming to describe the advantages and limits of such a technique, we've realised a narrative literature review using PubMed, Scopus, Google Scholar, and Web Of Science databases from their inception through January 2024. The following search strings were "robotic surgery AND vesicovaginal fistula", "robot-assisted surgery AND vesicovaginal fistula", "robotic surgery AND vesicovaginal fistula repair", "robot-assisted surgery AND vesicovaginal fistula repair". English restriction was applied. Studies that were not focused on robot-assisted VVF management were excluded. The selection included original research articles, clinical guidelines, retrospective and prospective cohort studies, case–control studies, case reports, and expert consensus statements. Three independent reviewers (G.C, M.M, and M.D.D) screened titles and abstracts for inclusion. As a narrative review, no formal guidelines were followed. A total of 315 results were found. After the selection process, 15 studies were included [12,17–30], results available on Table 2. Most of the study population was in their forties, with a mean age of 47. The most common cause of VVF was iatrogenic injury following surgical procedures, such as hysterectomy or mesh placement for urinary incontinence. Most patients underwent primary robotic VVF repair more than 12 weeks after the initial surgery. A total of 80 cases were reported. The mean fistula size, described in 8 out of 15 studies (53.3%), was 1.49 cm. The mean blood loss, reported and quantified in 11 out of 15 studies (73.3%), was minimal and clinically insignificant, averaging 73.08 ml. The median operative time, specified in 11 out of 15 studies (73.3%), was 197.27 minutes. Console time was separately reported in only 2 out of 15 studies (13.3%), with a mean duration of 133.75 minutes. In 13 out of 15 studies (86.7%), an interposition flaps enhanced fistula closure and healing. The most utilized flaps included omental flaps (6/13), sigmoid epiploicae (1/13), colonic epiploicae (1/13), peritoneal flaps (2/13), and amniotic allograft interposition tissue flaps (2/13). In one study, fibrin glue was employed as an alternative. Regarding urinary diversion devices, five studies did not specify their use, one reported the absence of any device, one utilized a ureteral catheter, and eight employed a Double J stent. No major postoperative complications were recorded. Only one study reported a minor event, classified as Clavien-Dindo grade I. The median follow-up duration across the included studies was relatively short (8.68 months) and did not exceed

12 months in 12 out of 15 studies (80%). However, long-term follow-up data from 2 out of 15 studies (13.3%) are promising, with durations of 14.25 and 28.3 months without recurrence. The success rate was 100% in 14 out of 15 studies (93.3%); only one study reported two cases of failure involving complex fistulas necessitating reintervention.

Since Melamund et al. first documented a robot-assisted vesicovaginal fistula (VVF) repair in 2005, the field has seen a growing body of evidence over the past decade [12]. Successful VVF repair relies on several key principles, including optimal visualization, careful dissection, precise tissue alignment, a tension-free and watertight closure, the use of well vascularized tissue flaps, and adequate postoperative urinary drainage [29,30]. While these fundamentals remain constant across different surgical approaches, minor variations exist. One of the most notable changes is the preference for a limited posterior cystotomy rather than a complete bladder bisection, which helps in reducing surgical trauma and shortening the suture line. Different strategies have been proposed to facilitate intraoperative fistula localization. One method involves cystoscopy illumination, where the robotic camera light is temporarily turned off to enhance visualization. Alternatively, a Foley or Fogarty catheter can be inserted through the fistula to aid identification [31]. A cost-effective approach, described by Bora et al., involves positioning a ureteric catheter through the fistula tract, allowing the scrub assistant to apply gentle traction to pinpoint the exact site, enabling a precise incision over the posterior bladder wall [22,29].

Historically, VVF management involved urinary diversion through feeding tubes, suprapubic catheters, and urethral catheters, primarily to ensure continuous drainage, prevent excessive bladder distension, and reduce the risk of suture dehiscence. In modern practice, DJ stents have become more common for ureteral drainage, while urethral catheters remain standard for bladder decompression. According to our literature review out of 15 studies 8/15 preferred DJ stents to secure ureteral drainage. The described cases secured an empty bladder using a urethral Foley catheter.

Multilayer closure and interposition flaps are widely recognized as key elements in the surgical management of vesicovaginal fistulas (VVF). While some approaches advocate for a double-layer bladder closure, others report similar success rates with a single layer technique. A review by Miklos et al. found no significant difference in outcomes between laparoscopic and robotic VVF repairs, regardless of whether a single layer or double layer closure was realized [32]. However, in an experimental study on mongrel dogs, Sokol et al. demonstrated improved outcomes with a double-layer bladder closure compared to a single-layer approach [33]. In this scenario, our institution has consistently adopted the double layer bladder closure to ensure a watertight, reinforced repair. This approach has yielded encouraging results that align with the existing evidence. Tissue interposition has been considered an effective practice in repairing VVFs; Different techniques have been described in the available literature. The most adopted tissues are omental/peritoneal flaps, sigmoid epiploic, and/or amniotic allografts. These flaps serve a dual purpose: from one side they allow creating a physical barrier between the bladder and vagina. At the same time, from the other they will enhance vascularity and promote tissue healing. However, the necessity of interposition flaps remains debatable, particularly in non-radiated patients. A study by Miklos et al. found no significant impact on cure rates with or without flaps, concluding that the quality of the fistula closure itself is the most critical factor for successful outcomes. This observation holds particularly true for simple VVFs. On the other hand, for recurrent VVF cases, evidence is conflicting, if Miklos et al. reported that in such instances, interposition grafts did not provide a clear advantage [32], Bora et al. reported the effectiveness of sigmoid epiploicae flaps, emphasizing their accessibility and proximity to the fistula site, which can be beneficial in specific clinical scenarios [29].

Surgical duration for robot-assisted VVF repair varies significantly in published studies, ranging from 95 to 305 minutes (Table 2). These differences stem from factors such as surgeon expertise and differences in how operative time is measured, with some studies reporting only console time. Blood loss during surgery is typically minimal, generally falling between negligible levels. Postoperative hospitalization is usually brief, reflecting the well-established benefits of minimally invasive surgery, which promotes faster recovery and reduced morbidity. Reported follow-up periods are inconsistent across studies, spanning from 3 to 28.3 months after surgery.

Complications following robotic VVF repair have been reported to be low. Gelhaus et al. reported a single immediate postoperative event, classified as Clavien grade 3, where the patient developed colonic dilation requiring colonoscopic decompression [26]. Additionally, two cases of recurrence were identified in the same cohort [29].

Complex vesicovaginal fistulas (VVF) are defined as those larger than 3 cm, those that have failed previous repairs or require reoperations, those with a distal margin within 1.5 cm of the bladder neck, post radiation fistulas, fistulas near the ureteric orifice, those with extensive fibrosis, or those associated with a rectovaginal fistula. Although trans-vaginal repair is minimally invasive, it poses technical challenges for supra-trigonal VVFs, in patients with radiation induced vaginal narrowing, or when simultaneous ureteric reimplantation is needed. While the prone transvaginal approach may alleviate some of these issues, its complex positioning can complicate aesthetic management. In contrast, the abdominal approach offers a more expansive operative field, enabling the repair of complex fistulas that may require ureteric reimplantation or augmentation cystoplasty, and allowing the use of interpositional tissues such as the Omentum without compromising vaginal length. Moreover, the advent of robot-assisted surgery has significantly reduced the morbidity associated with open transabdominal repairs, providing improved ergonomics, enhanced suturing in the confined pelvic space, and magnified visualization for precise reconstruction of complex fistulas [33,34].

A key measure of success in vesicovaginal fistula (VVF) repair is the restoration of urinary continence. While the application of robot-assisted techniques in VVF surgery is expanding, current reports remain limited due to small patient cohorts and short follow-up durations. Most studies indicate high success rates, with nearly all published series except one showing a 100% closure rate. However, larger studies are still lacking, making it difficult to draw definitive conclusions. One of the most comprehensive analyses, conducted by Bora et al., reported a 93% success rate, with two cases of recurrence out of 30 patients, both involving complex fistulas [29]. These outcomes are comparable to those observed in laparoscopic and open approaches, as documented by Milkos et al., suggesting that robotic techniques may offer similar effectiveness with the potential benefits of minimally invasive surgery [35]. Despite successful anatomical closure, a subset of patients up to 20% may continue to experience urinary incontinence due to factors unrelated to the fistula itself. Bengston et al. developed a predictive risk model to address this, analysing 401 VVF cases to identify patients at higher risk for persistent incontinence after surgery. This underscores the importance of preoperative counselling, ensuring patients understand the potential for residual incontinence even after a technically successful repair.

Robotic surgery combines the benefits of laparoscopy with stereoscopic vision and the ability to employ wrist movements commonly used in open surgery. Enhanced and highly magnified three-dimensional (3-D) high-definition (HD) vision, improved dexterity, accurate depth perception with an immersive surgical experience and enhanced ergonomics offer surgeons advanced capabilities and patients improved outcomes [17,35-42].Furthermore, these technical benefits are highlighted by its low morbidity, namely reduced blood loss, shorter hospital stays, faster recovery times, and superior functional and cosmetic outcomes [15]. However, based on a consensus review of existing literature by the European Association of Urology Robotic Urology Section (ERUS) Scientific Working Group for Reconstructive Urology, there is no consensus recommendation for robotic VVF repair. The selection of the surgical approach (i.e. vaginal or abdominal, laparoscopic, or with robotic assistance), the decision to use flaps, and whether to opt for a trans or extra-vesical approach, should be tailored to the characteristics of the patient and the fistula itself [34].

The results from our research encourage the adoption of robot assisted VVFs repair in primary and recurrent cases, considering its successful rate associated with short- and long-term good outcome. Limitation from our study is the little number of available cases, bigger sample are needed to increase the accuracy of our results.

CONCLUSIONS

Robot-assisted VVFs surgical repair represents a state-of-the-art treatment, combining advanced technology with surgical expertise to achieve optimal postoperative outcomes. In our experience, it is feasible, safe, effective, and represents a viable approach, especially in complex cases. With its intrinsic technique advantages, the robotic approach allowed access to narrow spaces otherwise difficult to reach, improving the procedure success rate and even management of re-do VVF repair cases. Ongoing advancements in robotic instrumentation, imaging modalities, and surgical techniques hold promise for further enhancing the safety, efficacy, and accessibility of this approach in the management of urogynaecology disorders.

COMPLIANCE WITH ETHICAL STANDARDS

Authors contribution: Conceptualization, M.M., G.A, M.G. and M.D.D.; Data curation, G.A. and G.A.; Formal analysis, G.A.; Funding acquisition, none; Investigation, M.M., G.A.; Methodology G.A.; Project administration, M.M.; Resources: M.M; Software, G.A.; Supervision, M.M., M. D.D.; Validation, M.M., M.D.D.; Visualization, M.M.; Writing—original draft preparation, G.A., C.B., V.Z., M.M., P.Q., M.G., M.D.D.; Writing—review & editing, G.A, C.B., V.Z., M.M., P.Q., M.G., M.D.D.;

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Study registration

Being a casa report, there no study registration.

Disclosure of Interests

The authors declare no conflict of interests.

Ethical Approval

For case report formal IRB approval is exempted, although all procedures performed were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards

Informed consent

Written Informed consent was obtained from all subjects involved in the study.

Data sharing

Data are available under request to the corresponding author.

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Table 1. Main phases of Robot-assisted VVF repair.

Endoscopic phase	- Cysto-vaginoscopy; safety JJ ureteral catheter placement - VVF tract identification via guidewire/5 Fr ureteral catheter
Robotic phase	- Port Placement and pneumoperitoneum induction: 8-mm robotic camera port 2 cm above the umbilicus using, two 8-mm robotic ports along the pararectal lines on both sides, an 8 mm port above the left iliac crest dedicated to the Da Vinci Xi fourth arm for bladder retraction, and supplementary 5 mm and 12 mm ports for the assistant, one near the right iliac crest and another between the optic port and the right 8 mm port - Intestinal adhesiolysis and Douglas pouch exposure - Isolation of the vesicovaginal space, exposing the fistula tract - Excision of the fibrotic tract tissue. One of two approaches is selected based on the degree of tissue scarring, adhesions, and the characteristics of the fistula. For patients with complex VVF , those with altered pelvic anatomy due to previous surgeries or radiotherapy, or fistulas located in the trigonal zone a trans vesical approach is used. This involves a monopolar longitudinal cystotomy of the posterior bladder wall for direct visualization of the fistula tract, followed by a circumferential "tennis racket-shaped" incision around the fistula margins with monopolar robotic scissors to excise the scarred and necrotic tissue. Alternatively, when feasible, the fistula is identified and excised using an external approach without a longitudinal cystotomy, ensuring precise removal of the fistulous tract with adequate margins of healthy tissue. In both methods, the excised tissue is sent for histopathological analysis - Closure of the vaginal and bladder breach with tension free techniques. The vaginal incision is then closed transversely using a continuous 3-0 monofilament synthetic absorbable suture whereas **the** bladder is closed longitudinally in two layers with a continuous 4-0 monofilament absorbable suture - Bladder water-tightness test - Interposition of Omentum or other tissue if technically feasible - Abdominal drainage and urinary catheter

JJ: double J; VVF: Vulvo vaginal fistula; Fr: French;

N.	Reference	Year	Patients (Number)	Age (years)	Fistula Dimensions (cm)	Blood Loss (mL)	Surgical Duration time (min)	Interposed Tissue	Urethral Drainage Method	Postoperative Complications	Mean Follow-Up (months)	Success Outcome (%)
1	Melamund et al. [12]	2005	1	44	N/A	50	280	Fibrin glue	Double-J stent	-	4	100% (1/1)
2	Sundaram et al. [17]	2006	5	26–68	3.1	70	233	Omental flap	Double-J stent (2/5)	-	6	100% (5/5)
3	Schimpf et al. [18]	2007	1	41	1	Minimal	240	Perisigmoid fat	Double-J stent	-	3	100% (1/1)
4	Sears et al. [19]	2007	1	47	N/A	Not measured	N/A	Omental flap	Not specified	-	NR	100% (1/1)
5	Hemal et al. [20]	2009	3	32	1–1.5	100	127.5 (console)	Pedicled peritoneal flap	Not specified	-	3	100% (3/3)
6	Gupta et al. [21]	2010	12	27	2.8	88	140 (console)	Amniofix; omentum; colonic epiploicae; peritoneum	Double-J stent	-	6	100% (12/12)
7	Kurz et al. [22]	2012	3	40–64	N/A	N/A	N/A	Peritoneal flap	Double-J stent	-	10	100% (3/3)
8	Rogers et al. [23]	2012	2	42–51	N/A	N/A	N/A	Omental flap	Not specified	-	12	100% (2/2)

9	Dutto and O'Rielly [24]	2013	1	56	0.8	N/A	N/A	Pedicled colonic epiploicae	Double-J stent	-	6	100% (1/1)
10	Bragayrac et al. [25]	2014	4	46	1.5	100	117.5	Omental flap	Double-J stent	-	14.25	100% (4/4)
11	Gellhaus et al. [26]	2015	10	52	N/A	52.8	249	Omental flap	Not specified	1	28.3	100% (10/10)
12	Martini et al. [27]	2016	1	43	N/A	50	95	/	Ureteric catheter	-	6	100% (1/1)
13	Price et al. [28]	2016	1	66	1	50	305	Amniofix	Not specified	-	5	100% (1/1)
14	Bora et al. [29]	2016	30	43	–	50	133	Omental flap; sigmoid epiploicae; peritoneum	None	-	6	93% (28/30)
15	Matei et al. [12,30]	2017	5	62	0.5	120	250	/	Double-J stent	-	12	100% (5/5)

Tab 2. Literature review about robot-assisted VVF repair cases.

Figure 1: Anatomical description of a VVF. A) Detailed view of the fistulous tract. B) Ureteral catheter (yellow), serving as a reference point for accurate identification and surgical planning.

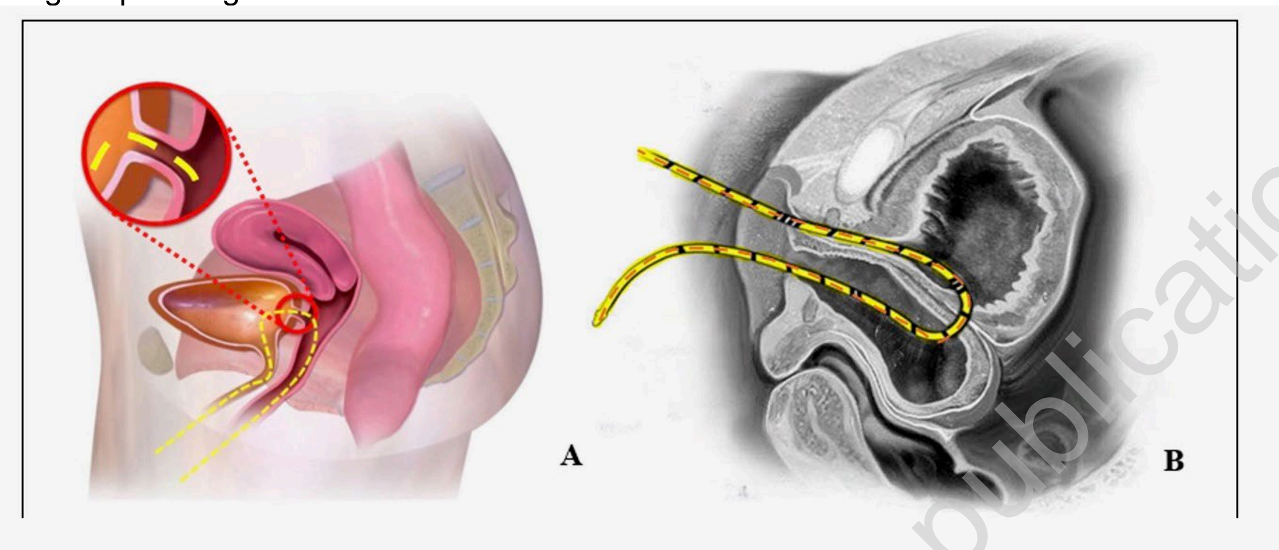

Figure 2: Retrograde cystourethrography image. Demonstration of a Fistulous communication be-tween the posterior wall of urinary bladder and anterior wall of vagina. Evident appearance of contrast fluid in the vaginal cavity

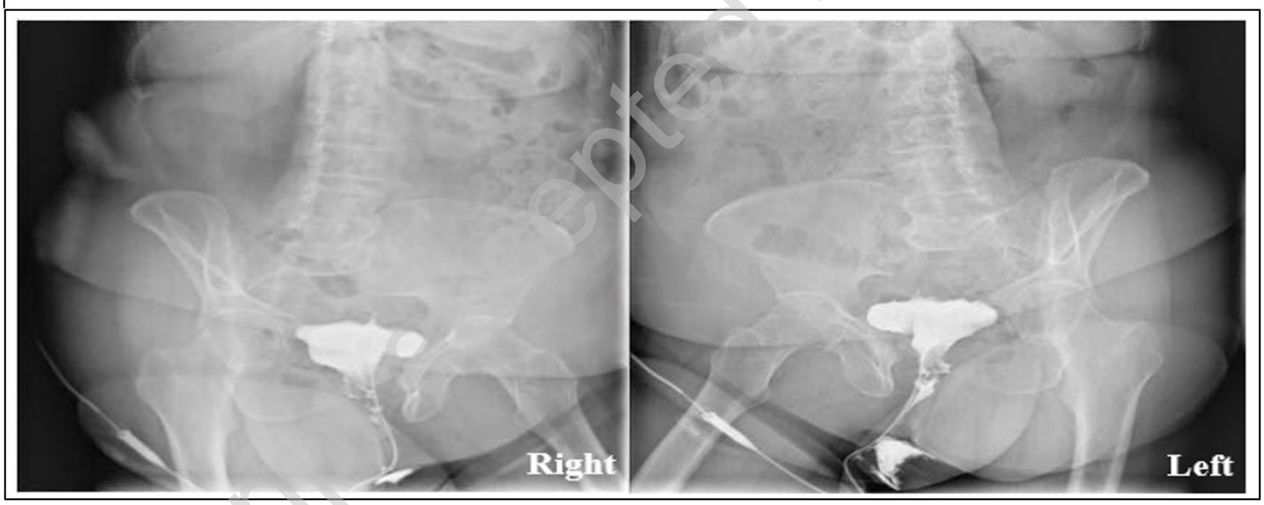

Figure 3: Schematic description of Robot-assisted extravesical vesicovaginal fistula repair. A) The fistulous tract is easily identified using a pre-positioned catheter from the preliminary endo-scopic phase. B) Once localized, the fistula is excised externally without a longitudinal cystotomy, ensuring precise removal of the tract and adjacent scar tissue with adequate margins of healthy tissue. C) Finally, the vaginal layer and bladder wall are sutured in opposing perpendicular orientation.

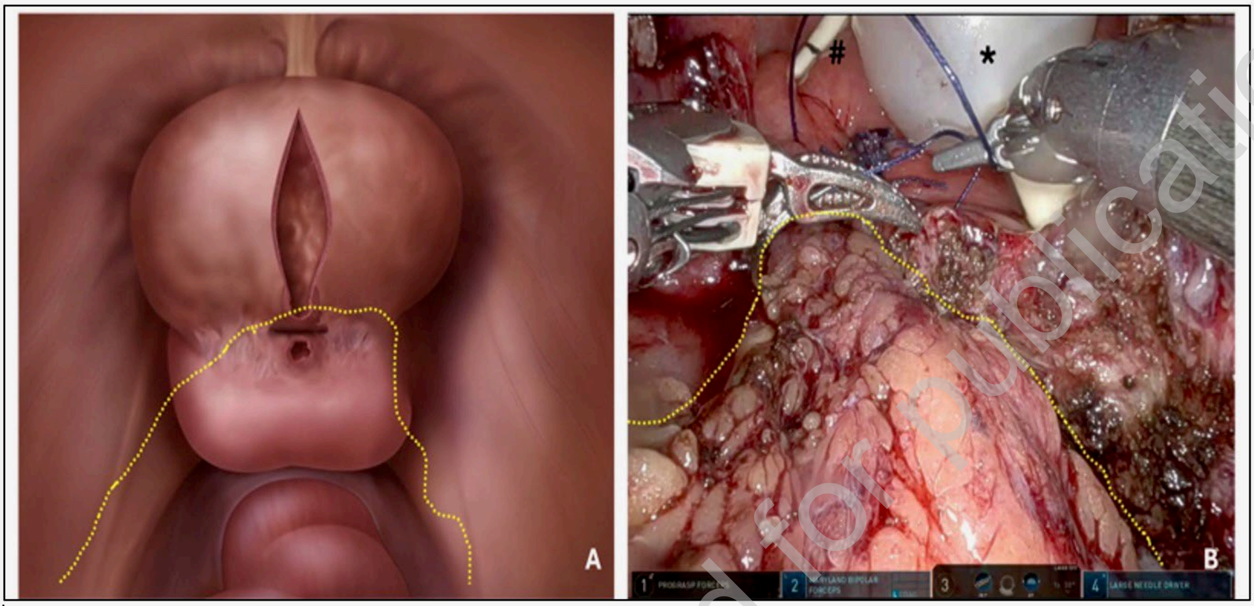

Figure 4: Schematic representation of omental flap interposition technique. A) Schematic representation of omental flap interposition (highlighted with a dashed yellow line) during robotic transvesical vesicovaginal fistula repair. B) The exposed bladder mucosa after cystotomy, the re-paired fistulous tract, the Foley catheter balloon (*), and a mono-J catheter (#) emerging from a ureteral orifice can be observed.

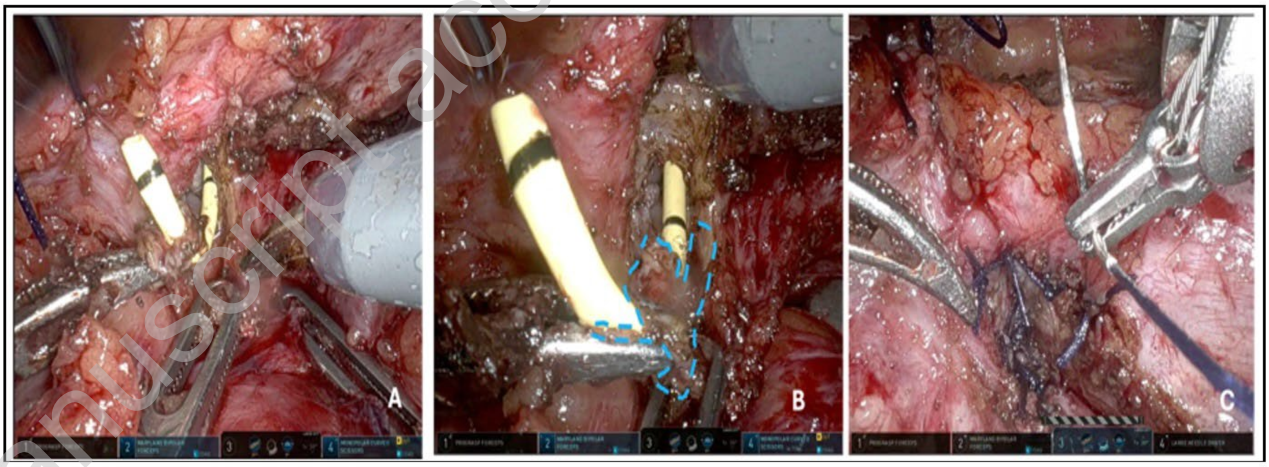

Figure 5: Schematic representation of urachal flap interposition technique. A) and B) In-traoperative findings showing the interposition of an urachal flap, supplemented by a peritoneal leaflet, between the bladder and vaginal walls to ensure suture line separa-tion and minimize the risk of fistula recurrence.