

Genitourinary Fistula Repair and the Factors Affecting Its Outcomes: 15 years Experience from a Tertiary Care Centre

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Abstract

Background: 474 patients who underwent genitourinary fistula repair at a tertiary centre were retrospectively analyzed, to determine the factors affecting the outcome of surgery.

Methods: A retrospective analysis was carried out on 474 patients who underwent transabdominal, transvaginal and laparoscopic repair in the last 15 years at our institute. The mean (SD) age was 36 year; 49% of the VVF occurred after abdominal hysterectomy, 32% after obstructed labour and 19% after Caesarean section. Twenty-nine (6.11%) had a previous failed repair operated elsewhere.

Results: Out of 474 VVF, 68 cases had more than one fistula on urethrocytostomy. Transabdominal repair was done in 245 patients, transvaginal repair in 156, total laparoscopic procedure was attempted in 49 and conservative approach in 24 patients. The average duration of urethral catheter placement (SD) was 22 (3.9) days. A total of 219 patients were left indwelling catheters in view of nearness to the orifice. The success rate of primary operation for open transabdominal, transvaginal, laparoscopic and conservative approach were 90%, 91.66%, 95% and 63% respectively. Only the surgical technique and previous history of repair were significant factors in the univariate analysis of variables that could affect surgery success. In multivariate analysis, only the previous intervention and surgical approach remained significant.

Conclusion: In surgical correction of VVF, both abdominal and vaginal approach seems to have comparable success. Laparoscopic VVF repair is evolving in a rapid trend because of its reduced morbidity, minimal blood loss, short hospital stays and high success rates. History of previous repair and the surgical factors determined the success rate of VVF repair. Recurrent VVF are being associated with lower success rates than primary cases at our institute.

Keywords: • Vesicovaginal fistula • Laparoscopy • Endoscopy • Health • Urology

Introduction

A fistula is an abnormal or surgically made passage between a hollow or tubular organ and the body surface, or between two hollow or tubular organs. In the developed world the increasing frequency of gynecologic surgery as well as pelvic radiation, forgotten vaginal foreign bodies, or uninhibited cancer growth are the modern causes for Vesicovaginal Fistulae (VVF) in elderly patients [1]. Careful planning and execution of gynecologic or cancer surgery and/or radiotherapy reduce the risk of iatrogenic fistula formation, although there is little research on the impact of preventive measures on this type of fistulae. Even in stage IV cervical cancer, treated with radiotherapy, clear risk factors could not be established [2].

In the developing world poor perinatal care and the lack of timely cesarean sections for women with an increased risk for obstetric fistula (OF) formation are the main causes in some regions of Africa, Asia, and South America. The risk factors for obstructed labor are well known: illiteracy, low economic status, and short stature. As resources increase within these countries, the number of obstetric fistulae seems to decrease, but those of iatrogenic fistulae seem to increase [3,4]. Injury to the bladder during gynecologic,

urologic, or other pelvic surgery is the most common cause (>75%) of VVF in the industrialised world [5,6].

Transabdominal, Transvaginal and laparoscopic repairs of VVFs have now been carried out at our institution in the last 15 years accordingly with surgeon experience and skills. The aim of this study is to highlight the factors possibly affecting success of surgical correction of VVF.

Methodology

After the Approval and Ethical clearance from Institutional review board. A retrospective analysis was carried out on 474 patients who underwent transabdominal, transvaginal and laparoscopic repair over the period of 15 years between January 2005 to January 2020 at the Department of Urology of our institute.

All patients with suspicion of fistulae underwent ascending cystogram with anteroposterior and lateral views. Upper urinary tracts were evaluated with ultrasonography and intravenous urography. A dye or gauze test used to confirm the diagnosis in case of small fistulas as well as the possibility of an associated ureterovaginal or ureterovaginal fistula. Urethrocytostomy is performed in all the case before the commencement of surgery. The cause of fistulae, history of previous repair and the duration of the VVF, were documented in all patients. The size of the fistulous opening, location and number of the fistulas were also recorded. The approach (abdominal or vaginal or laparoscopic) and the use of an interposition flap were noted. Duration of the catheter and use of bilateral ureteric splints are also documented in all patients.

All patients have to wait for minimum of 3 months before surgery as an institution protocol except for ureterovaginal fistulas, which they will undergo surgery within one month after presentation. Five urology consultants perform surgeries at our institute. Patients were operated with transabdominal. Transvaginal and laparoscopic approach according to the surgical experience and expertise. For transvaginal repair, patient will be placed in the extended lithotomy or the prone jack-knife position. Circumferential incision given around the fistula following which vaginal and bladder walls are well separated carefully. Following tract excision, Bladder wall is closed in two layers with interrupted vicryl 3-0 sutures and if necessary then a Martius labial fat pad is interposed and then the vaginal wall is closed using interrupted vicryl 2-0 sutures. Postoperative drainage is done with both urethral and suprapubic catheters.

For Transabdominal repair, patient is laid supine and Ureteral catheters placed preoperatively if the VVF is in close proximity to the ureteric orifices. A lower midline incision or transverse incision is given according to the surgeon desire. The bladder is bivalve vertically, and the cystotomy is extended to the level of fistula. VVF tract is excised and a plane is created between the vagina and the bladder and extended for a distance of 2 to 3 cm beyond the VVF. The vaginal defect is approximated with an absorbable suture. An inter-positional flap of greater omentum is to be used after closure of vaginal defect, it is mobilized and then secured 1cm to 2 cm distally beyond the excised VVF tract. The bladder is then closed in two layers. A suprapubic tube and urethral catheter are left for postoperative drainage.

For a laparoscopic VVF repair, before beginning the surgery, ureteral stents are placed, and the procedure is performed in the same way as a transabdominal VVF repair. At our institute, glue is used only for small supratriangular fistulas and injected under cystoscopic guidance after freshening fistula margins. Anticholinergic agents are used in the postoperative period to minimize bladder irritability. After any form of VVF repair the patient is advised to abstain from sexual intercourse for 3 months. Urethral catheters and suprapubic catheters are removed at 4 weeks to 6 weeks.

Ureterovaginal fistula is repaired via standard ureteric re-implantation with or without psoas hitch. Rarely some case required Boari's flap. Urethrovaginal fistula were repaired were repaired in the similar manner as that of transvaginal VVF repair.

A univariate analysis was used to assess individual variables, with the chi-squared test; those variables significant on univariate analysis were considered in a multivariate analysis, using logistic linear regression. In all tests, significance was indicated at P<0.05.

Results

From January 2010 to January 2020, 474 patients underwent genitourinary fistula repair at our institution. The most common cause of vesicovaginal fistula at our institution is hysterectomy (laparoscopic/open approach) comprising 231 cases, among obstetric cause obstructed labour was the most common cause with 142 cases, 85 cases were secondary to LSCS, 8 cases were secondary to malignancy and other causes like D&C, vaginoplasty, SPCL, forceps delivery, trauma, h/o cystolithotomy, previous VTF repair constituted 3% of cases.

The mean age of patients was 36 years. Average fistula size was 1.69 cm. 29 patients had h/o previous VVF repair operated outside (supratrigonal 19, trigonal 10). Fistula location and associated conditions as shown in Table 1. There were 296 supratrigonal defect with an average size of 1.8cm, 154 trigonal fistulas with average defect size of 1.98cm and 13 cases of urethrovaginal fistulae. There were 29 ureterovaginal fistulae, 20 out of which were associated with vesicovaginal defect, 7 patients with uterovesical fistula (Youssef syndrome), there were total 8 cases of rectovaginal fistula with 7cases secondary to obstructed labour and 1 case secondary to hysterectomy.

Table 1. Fistula location and associated conditions.

Location	Total Cases (%)
Supratrigonal VVF	269(56.75)
With ureterovaginal fistula	15(3.1)
With rectovaginal fistula	2(0.4)
With meatal stenosis	1(0.2)
malignant	2(0.4)
Uterovesical fistula(all are supratrigonal)	7(1.4)
Trigonal VVF	138(29.11)
With Ureterovaginal fistula	5(1.05)
With rectovaginal fistula	4(0.8)
With meatal stenosis	1(0.2)
Both supratrigonal and trigonal	6(1.2)
Isolated ureterovaginal fistula	9(1.8)
Rectovaginal fistula	2(0.4)
Urethrovaginal defect	13(2.7)

Total of 245 patients underwent transabdominal repair, and 35 patients with ureteroneocystostomy with indication for concomitant ureterovaginal fistula in 29 cases and VVF involving the ureteric orifice in 16 patients as shown in Table 2. Omentum as a flap was used in all patients. There were 156 transvaginal repairs with martial flap used in 125 patients, peritoneal flap in 8 patients. Our experience with glue was limited. We used it in 24 patients and 15 of the fistulas recurred. In 5 patients with large VVFs (both>4 cm) and small capacity bladders we augmented the urinary bladder with ileum in 4cases and one patient underwent open transabdominal VVF repair with mitrofanoff procedure for severe meatal stenosis. 49 patients underwent laparoscopic transperitoneal repair, 8 patients were converted to open in view of intra operative difficulty. All rectovaginal fistula and concomitant VVF underwent diversion ileostomy prior to definitive repair and were closed after successful repair of the fistula at our institution.

Table 2. Total number of surgical procedures with their failure rates.

Types of surgeries	Total number of cases(%)	Failures(%)
Transabdominal repair	193(40.72)	20(37.74)
With ureteroneocystostomy	35(7.38)	3(5.66)
With indiana pouch procedure	2(0.42)	0(0.00)
Laparotomy and repair	3(0.63)	1(1.89)
With mitrofanoff procedure	1(0.21)	0(0.00)
With ileal augmentation	2(0.42)	1(1.89)
With hysterectomy	2(0.42)	0(0.00)
With incisional hernia repair	1(0.21)	0(0.00)
With Boari flap	1(0.21)	0(0.00)
Both transabdominal and transvaginal repair	5(1.05)	2(3.77)

Transvaginal repair	155(32.70)	13(24.53)
With urethral diverticulectomy	1(0.21)	0(0.00)
Conservative management	24(5.06)	9(16.98)
Laparoscopic repair	41(8.65)	2(3.77)
Laparoscopic approach converted to open	8(1.69)	2(3.77)
	474	53

The success rate of primary operation at our institution is 91.66% for transvaginal repair(143/156), 90% for transabdominal procedure(173/193), 95% for laparoscopic repair(39/41), 75% for patients with lap converted to open procedures(6/8), 63% for conservative approach(15/24) and 91% for patients undergoing both VVF repair and ureteroneocystostomy together(32/35). Patients which required additional procedures like laparotomy, boari flap, rectovaginal fistula repair, mitrofanoff procedure and all rectovaginal repair were excluded to assess the actual success rates of the repair.

The mean operative duration was 78 mins ± 18.1 mins, 112 mins ± 17.2 mins, 71 mins ± 12.6 mins for transvaginal repair, transabdominal repair and laparoscopic repair respectively. Mean blood loss was 65 mL ± 13.4 mL, 90 ml ± 15.1ml, 40 ml ± 10.1ml for transvaginal repair, transabdominal repair and laparoscopic repair respectively. The mean postoperative hospitalization time was 8 days ± 3.8 days (range 6 days–13 days), 10 ± 5.8 (range 5 days-16days) and 6 days ± 2.3 days (range 4 days-9 days) respectively.

There were total of 53 failed repairs as shown in Table 3, 11 of which had previous repair elsewhere and rest of them were primary failures. Out of which 15 patients lost to follow up and they never returned (3 from the previous repair group and 12 from primary failure group). Rest 38 patients underwent another repair at our institution with success rate of 75% for transvaginal repair (3/4) and 92% for transabdominal repair (35/38). 1 patient with previous two repairs has failed and 2 patients lost to follow up after another repair.

Table 3. Characteristics of failed cases.

Failed Cases	Previously operated failure	Primary failure at our institution
Total numbers	11	42
Lost for follow up after 1st surgery at our institute	3	12
Redosurgery failures	1	3
Lost for follow up after another surgery	1	1

In a univariate analysis, history of previous repair and approach to surgery had a significant impact on surgery outcomes as shown in Table 4. On using a multivariate regression model, the underlying history of previous repair (OR 2.4) and type of surgery (OR 2.5) were found to be significant factors affecting outcome.

Table 4. Local variables affecting the success of VVF.

Variable	Failed	Success	Total	P, CHI
Previous Repair				
No	42	403	445	
Yes	11	18	29	2.38E-07
Duration of VVF (Months)				
<6	29	194	223	0.2351717
>6	24	227	251	
Size of Fistula (cm)				
0.5-1	20	147	167	0.286886

1.0-2.0	9	114	123	
2.0-3.0	11	91	102	
>3.0	13	69	82	
Location				
Supratrigonal	32	264	296	
Trigonal	17	137	154	0.7222331
Urethral	2	11	13	
Ureteral	2	7	9	
Fistula Number				
Single	42	360	402	
Multiple	11	57	68	0.167207
Approach				
Abdominal	27	218	245	
Vaginal	13	143	156	0.0001693
Laparoscopic	2	39	41	
Conservative	9	15	24	
Catheter Duration				
<21	22	173	195	
>21	31	248	279	0.9536586
Ureteric Stents				
No	28	227	255	
Yes	25	194	219	0.8808646

Discussion

In our study obstetric causes were found in 231 cases (48.73%) followed by gynaecological causes in 142 cases (29.9%), 85 cases were secondary to LSCS (17.93%) and 8 cases were secondary to malignancy (1.68%). In our study, of the total 474 VVFs, the success rate of primary operation is 91.66% for transvaginal repair (142/155), 90% for transabdominal procedure (173/193), 95% for laparoscopic repair (39/41), 75% for patients with lap converted to open procedures (6/8), 63% for conservative approach (15/24). 91% for patients undergoing both VVF repair and ureteroneocystostomy together (32/35). These results are similar or superior to the results reported elsewhere Sharma et al [7] reported on 25 patients who had omental flaps implanted, 21 of whom were successful. In 34 patients, Wein et colleagues [8] used the transvesical technique with peritoneum or omentum interposition, with 30 of them having satisfactory repair. For 42 patients, O'Connor et al. performed a suprapubic transvesical technique, with 37 of them undergoing effective repair [9]. Patil employed a gracilis in 18 patients, with 13 of them having a positive outcome [10].

Identifying the fistula, creating a dissection plane between the vaginal wall and the urethra, watertight closure of the urethral wall, ultimate interposition of tissue, and closure of the vaginal wall are all surgical principles described by most authors. Primary closure rates of 53% to 95.4% have been

described. In our series patient who underwent transvaginal repair had similar level of success to that of literature which is around 92%.

When extra bulking with well-vascularized tissue is required in the treatment of GU fistulae, the Martius flap is considered to be a useful supplementary technique [11]. Rangnekar et al. studied 12 patients with urethrovaginal fistulas, 8 of whom had a Martius flap and 4 of whom received a traditional repair. Only one of the eight experienced a recurrence of the fistula, while three of the four traditional procedures failed.; however, these cases were not randomized between surgical techniques [12]. Other alternatives are peritoneal flap, omental flap, rectus muscle and gracilis muscle flap. In our series there were 156 transvaginal repairs, martial flap used in 125 patients, peritoneal flap in 8 patients. None of the patients with usage of flaps recurred during the study period.

Laparoscopic VVF repair as well as robotic assisted VVF repair has gained importance since 2005. Laparoscopic VVF repair is most useful in the same situations as transabdominal VVF repair, such as when the VVF is high and a vaginal procedure would be anatomically difficult. In certain individuals, dense pelvic adhesions and/or inflammation from prior abdominal surgery make this method less favourable. Compared with the transabdominal approach, laparoscopic repair is reported to be associated with less surgical trauma, shorter convalescence, and lower morbidity without compromising the results [13-16]. In laparoscopic repair of VVF either the O'Connor technique or the extravesical technique are used [17]. All 41 patients underwent laparoscopic intraperitoneal extravesical approach using the modified O'Connor technique. In our study the success rate was 95%, which was comparable to the literature around the world.

The most common cause of ureterovaginal fistulas is injury to the distal one-third of the ureter below the level of the iliac vessels. The most common type of open surgical repair is ureteric re-implantation. The ureter is divided distally, and a ureteroneocystostomy is performed with or without a psoas hitch. It is not important to create a tunneled anastomosis. Occasionally a Boari flap or replacement with bowel segments (with or without reconfiguration) may be necessary because of extensive ureteral injury. A total 29 cases of UVF were included in our series, all of them were caused by gynaecological surgery. The incidence of combined ureterovaginal and vesicovaginal fistula which is 8.43% (20/474) in the present series. According to the literature the success of ureterovaginal repair is more than 90% of cases. Blandy et al. (1991) reported on early repair of iatrogenic injury to the ureter in 43 cases including 30 ureterovaginal fistulae. All patients were cured using a combination of techniques including the Boari flap [18]. In our series, all renal units were salvaged with 32 successful ureteroneocystostomy and unilateral boari's flap in 2 cases with a success rate of 91% in the present series.

Vesicouterine fistulae are among the least common types urogynecologic fistulae [19,20]. However, with increasing trends of lower segment caesarean section performed all over the world there is increasing incidence of uterovesical fistulas [21,22]. Total 7 cases of VUF presented to our institution secondary to LSCS in 5 patients and D & C in 2 patients. In our series there were a total of 13 cases and all of them (100%) were due to obstetric causes. Management of patients with uterovesical fistula depends of the childbearing desirability of the female patients. If patients wish for future fertility Uterine-sparing procedures can be used, and successful pregnancy is possible after vesicouterine fistula repair. In present series none of the patient underwent hysterectomy. All underwent open abdominal exploration and repair.

Recurrent VVFs are complex and are difficult to deal with, minimum of 6 months gap should be encouraged before performing the redo surgery. Consideration should always be given for the interposition flaps. The tissue graft could be harvested from the surrounding tissues, with stalk (flap), or it could be a free graft from a distant tissue or an organ. In transvaginal procedures, various local flaps could be used: labial fat tissue flap (Martius flap), labial skin flap, vaginal flap, bulbocavernosus muscle flap, and tubular gluteal skin graft [23-26]. In transabdominal approach, the flaps can be used from the visceral peritoneum, posterior wall of the uterus, rectus abdominis flap, rotational bladder flap, urachal flap, and perisigmoid fat flap [27-30]. In the present series, 53 patients out of 474 had recurrence of fistula. 11 out of which were recurrent fistulas primarily operated at our institute and rest 42 patients had primary recurrence after undergoing repair at our institute. Nearly 28% (15 patients) were lost to follow up after 1st recurrence. The success rate of redo surgery at our institute approximates around 80% - 85%.

There are certain limitations to our study. Firstly, it is retrospective in nature. Second, our data came from a state-run tertiary referral institution in Northern India, where the majority of patients are from rural areas with poor socioeconomic status. Third, our study had a short follow-up period because these patients are from one of society's most neglected groups, and many of them are lost to follow-up, so we could only quantify success at the last visit.

Conclusion

In conclusion Genitourinary fistulae are socially debilitating. Gynaecological surgeries are evolving as the major cause of genitourinary fistula in India. Surgical treatment of genitourinary fistulae depends on size and location of fistula. In surgical correction of VVF, both abdominal and vaginal approach seems to have comparable success in our hands. Laparoscopic VVF repair is evolving in a rapid trend because of its high success rates, reduced morbidity, minimal blood loss and short hospital stay. Recurrent VVF are particularly complex, being associated with lower success rates than primary cases. High rates of successful fistula closure can be achieved irrespective of etiology by following sound surgical principles of fistula repair.

References

- Hampel, C., et al. "Vesicovaginal fistula: Incidence, etiology and phenomenology in Germany." *Urologe* 54 (2015): 349-358.
- Biewenga, Petra, et al. "Can we predict vesicovaginal or rectovaginal fistula formation in patients with stage IVA cervical cancer?." *Int. J. Gynecol. Cancer* 20.3 (2010).
- Tebeu, Pierre Marie, et al. "Risk factors for obstetric fistula: a clinical review." *Int. urogynecology j.* 23 (2012): 387-394.
- Wright, Jeremy, Fekade Ayenachew, and Karen D. Ballard. "The changing face of obstetric fistula surgery in Ethiopia." *Int. J. Women's Health* (2016): 243-248.
- De Ridder, Dirk. "An update on surgery for vesicovaginal and urethrovaginal fistulae." *Curr. opin. urol.* 21.4 (2011): 297-300.
- M El-Mogy, Abd Allah, et al. "Iatrogenic urinary tract injury in obstetric and gynecological procedures: five-year-experience from two university hospitals." *Al-Azhar Med. J.* 50.1 (2021): 153-162.
- Sharma, S. K., et al. "Pedicled omental graft in repair of large, difficult vesicovaginal fistulae." *Int. J. Gynecol. Obstet.* 17.6 (1980): 556-559.
- WEIN, ALAN J., et al. "Repair of vesicovaginal fistula by a suprapubic transvesical approach." *Obstet. Gynecol. Surv.* 35.5 (1980): 324-326..
- O'conor Jr, Vincent J. "Review of experience with vesicovaginal fistula repair." *J. Urol.* 123.3 (1980): 367-369.
- Patil, Umesh, Keith Waterhouse, and Gobind Laungani. "Management of 18 difficult vesicovaginal and urethrovaginal fistulas with modified Ingelman-Sundberg and Martius operations." *J. Urol.* 123.5 (1980): 653-656.
- Goh, Judith TW, et al. "Predicting the risk of failure of closure of obstetric fistula and residual urinary incontinence using a classification system." *Int. Urogynecology J.* 19 (2008): 1659-1662.
- Rangnekar, N. P., et al. "Role of the Martius procedure in the management of urinary-vaginal fistulas." *J. Am. Coll. Surg.* 191.3 (2000): 259-263.
- Ghosh, et al. "Comparative analysis of outcome between laparoscopic versus open surgical repair for vesico-vaginal fistula." *Obstet. gynecol. sci.* 59.6 (2016): 525-529.
- Gupta, Narmada P., et al. "Comparative analysis of outcome between open and robotic surgical repair of recurrent supra-trigonal vesico-vaginal fistula." *J. endourol.* 24.11 (2010): 1779-1782.
- Aminsharifi, Alireza. "Minimally Invasive Management of Genitourinary Fistula: Intravesical Versus Extravesical Approach." *J. Gynecol. Surg.* 35.2 (2019): 127-127.
- Xiong, Yang, et al. "Transperitoneal laparoscopic repair of vesicovaginal fistula for patients with supratrigonal fistula: comparison with open transperitoneal technique." *Int. urogynecology j* 27 (2016): 1415-1422.
- Miklos, John R., and Robert D. Moore. "Laparoscopic extravesical vesicovaginal fistula repair: our technique and 15-year experience." *Int. urogynecology j.* 26 (2015): 441-446.
- Blandy, J. P., et al. "Early repair of iatrogenic injury to the ureter or bladder after gynecological surgery." *J. urol.* 146.3 (1991): 761-765.
- Rajamaheswari, N., and Archana Bharti Chhikara. "Vesicouterine fistulae: our experience of 17 cases and literature review." *Int. urogynecology j.* 24 (2013): 275-279.
- Schwartzwald, David, et al. "Vesicouterine fistula with menouria: a complication from an intrauterine contraceptive device." *J. urol.* 136.5 (1986): 1066-1067.
- Kumar, A., et al. "Management of vesico-uterine fistulae: a report of six cases." *Int. J. Gynecol. Obstet.* 26.3 (1988): 453-457.
- Porcaro, Antonio B., et al. "Vesicouterine fistulas following cesarean section Report on a case, review and update of the literature." *Int. urol. nephrol.* 34 (2002): 335-344..
- Stanojević, Dušan, et al. "Repair of vesicovaginal fistula caused by radiation therapy with labia maiora skin flap." *Srp. arh. za celok. lek.* 138.5-6 (2010): 356-361..
- Shoukry, Mohamed S., et al. "Vaginal flap re-enforcement of vesico-vaginal fistula repair." *Int. urogynecology j.* 21 (2010): 829-833.
- Fu, Qiang, Wei Bian, and Jiajv Lv. "Bulbocavernosus Muscle Flap for the Repair of Vesicovaginal Fistula: Anatomic Study and Clinical Results." *Urol. Int.* 82.4 (2009): 416-419.
- Choudhrie, Ashish V., Ajit J. Thomas, and Ganesh Gopalakrishnan. "Vesicovaginal fistula repair using tunneled gluteal cutaneous fat-pad flap." *Int. Urogynecology J.* 20 (2009): 121-122.
- Lentz, Samuel S. "Transvaginal repair of the posthysterectomy vesicovaginal fistula using a peritoneal flap: the gold standard." *J. Reprod. Med.* 50.1 (2005): 41-44.
- Reynolds, W. Stuart, et al. "Vesicovaginal fistula repair with rectus abdominus myofascial interposition flap." *Urology* 71.6 (2008): 1119-1123.
- Sharifiaghdas, Farzaneh, and Maryam Taheri. "The use of a rotational bladder flap for the repair of recurrent mixed trigonal-supratrigonal vesicovaginal fistulas." *Int. J. Gynecol. Obstet.* 119.1 (2012): 18-20.
- James, Mary Henderson, et al. "The urachal flap: a previously unreported tissue flap in vesicovaginal fistula repair." *Urogynecology* 19.3 (2013): 148-151.