Section: Miscellaneous

Review Article

ETIOLOGICAL PATTERNS, TIMING OF REPAIR, AND POSTOPERATIVE FUNCTIONAL OUTCOMES IN VESICOVAGINAL FISTULA: A SYSTEMATIC REVIEW IN URO-GYNECOLOGICAL PRACTICE

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ABSTRACT

Background: Vesicovaginal fistula (VVF) is a devastating uro-gynecological condition characterized by an abnormal communication between the bladder and vagina, resulting in persistent urinary incontinence and profound physical, psychological, and social suffering. Despite advances in obstetric care and surgical technique, VVF remains a significant public health burden — particularly in low-resource settings where maternal health infrastructure is limited. **Objectives:** This systematic review aimed to: (1) examine etiological trends associated with VVF; (2) compare clinical outcomes of early versus delayed surgical repair; and (3) evaluate postoperative functional outcomes including urinary continence, sexual function, quality of life, and recurrence rates. **Materials and Methods:** A PRISMA-guided systematic literature review was conducted across PubMed, Scopus, Web of Science, Google Scholar, and Cochrane Library for articles published between 2016 and 2026. After screening 1,290 records, 110 studies meeting all eligibility criteria were included. Data were extracted on etiology, surgical timing, operative approach, and postoperative outcomes. Methodological quality was assessed using the Newcastle-Ottawa Scale and the Cochrane Risk-of-Bias Tool. **Results:** Obstetric trauma — particularly prolonged obstructed labor — remained the predominant cause of VVF in developing countries (up to 75% of cases in sub-Saharan Africa), while iatrogenic injury during gynecological surgery accounted for the majority of cases in high-income settings. Both early repair (within three months) and delayed repair demonstrated success rates of 85–92% when applied under appropriate clinical conditions. Vaginal repair was the most frequently employed technique (success rate 85–90%), while laparoscopic and robotic-assisted approaches yielded rates exceeding 90% in specialized centers. Urinary continence was restored in 80–92% of patients, with notable improvements in psychosocial well-being and social reintegration following successful surgery. **Conclusion:** VVF management requires a patient-centered, multidisciplinary approach. Surgical success is contingent on timely diagnosis, appropriate technique selection, and comprehensive postoperative follow-up. Strengthening obstetric services in low-resource settings and improving intraoperative safety in surgical practice remain essential priorities for reducing the global burden of VVF.

INTRODUCTION

1.1 Background and Pathophysiology

Vesicovaginal fistula (VVF) refers to an abnormal communication between the urinary bladder and the vaginal canal, resulting in continuous, involuntary urinary leakage through the vagina. More than a urological complication, VVF is a multidimensional condition that carries devastating physical, emotional, and social consequences for affected women. The persistent wetness, skin breakdown, malodor, and social stigmatization associated with unrepaired fistulas frequently result in isolation, marital disruption, and severe psychological distress (Medlen, 2023).

The pathophysiology of VVF varies by etiology. In obstetric cases, prolonged obstructed labor results in sustained compression of the soft tissues between the descending fetal head and the maternal bony pelvis. This compressive ischemia leads to pressure necrosis of the bladder base and anterior vaginal wall, and the resultant devitalized tissue eventually sloughs —

leaving behind a fistulous tract. In iatrogenic cases arising during pelvic surgery, inadvertent cystotomy, thermal injury, or devascularization of adjacent tissues during procedures such as hysterectomy or cesarean section may produce immediate or delayed fistula formation (El-Azab, 2019; Medlen, 2023).

1.2 Global Epidemiology

The epidemiology of VVF is markedly polarized along lines of healthcare access and socioeconomic development. In high-income countries such as those in North America and Western Europe, VVF is relatively uncommon and most frequently arises as a complication of gynecological surgery — predominantly hysterectomy, which carries an estimated VVF risk of approximately 0.1–0.2% (Hilton, 2016). In striking contrast, VVF remains a major public health crisis across sub-Saharan Africa and South Asia, where obstetric fistulas continue to affect millions of women who lack access to skilled birth attendance and emergency obstetric services. Global prevalence estimates suggest that approximately 2–3 women per 1,000 of reproductive age are affected in low-income regions, with tens of thousands of new cases occurring each year (Zeleke et al., 2025; Thompson et al., 2023).

1.3 Etiological Diversity

The etiology of VVF is geographically heterogeneous. In developing regions, obstetric trauma accounts for the vast majority of cases, driven largely by prolonged obstructed labor in settings where access to timely cesarean delivery is limited. In developed healthcare systems, iatrogenic injury during gynecological and pelvic surgery predominates. A smaller proportion of cases across all settings arises from radiation-induced tissue necrosis following pelvic cancer therapy, traumatic injury, or direct tumor invasion by gynecological or urological malignancies (Wang et al., 2026; El-Azab, 2019).

1.4 Significance of Surgical Timing

The timing of surgical intervention is a clinically critical determinant of VVF repair outcomes. Some authors advocate for early repair — generally performed within 72 hours to three months of fistula diagnosis — on the grounds that prompt closure limits fibrosis and shortens the duration of morbidity. Others favor a delayed approach, allowing three to six months for inflammation to subside and tissues to regain adequate vascularity before reconstruction is attempted. This clinical controversy remains unresolved, and individualized decision-making — guided by fistula size, tissue quality, the presence of infection, and the patient's overall health status — is widely considered the most appropriate framework (Tatar et al., 2017; Rajaian et al., 2019).

1.5 Postoperative Functional Outcomes

Successful VVF repair aims not only to achieve anatomical closure of the fistulous tract but also to restore urinary continence and improve the patient's overall quality of life. Postoperative outcomes of interest include urinary continence rates, recurrence, sexual function, psychosocial recovery, and long-term social reintegration. Given the profound psychosocial burden that VVF imposes, holistic care encompassing surgical, psychological, and rehabilitative support is widely recognized as essential to comprehensive management (Chinthakanan, 2023).

1.6 Rationale and Objectives

Although numerous studies have examined individual aspects of VVF — its causes, surgical techniques, or postoperative results — integrated comparative analyses that simultaneously examine etiological patterns, repair timing, and functional outcomes are scarce. The present systematic review addresses this gap by synthesizing evidence from peer-reviewed studies published between 2016 and 2026, with the aim of informing evidence-based clinical practice in uro-gynecology.

The specific objectives of this review are

1. To characterize etiological trends associated with vesicovaginal fistula across different geographic and healthcare settings.
2. To compare the clinical outcomes of early versus delayed surgical repair of VVF.
3. To evaluate postoperative functional outcomes — including continence, sexual function, recurrence, and quality of life — across surgical approaches and patient populations.

MATERIALS AND METHODS

2.1 Study Design

This study was conducted as a Systematic Literature Review (SLR) following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines (Page et al., 2021). The PRISMA framework provided a transparent, reproducible, and methodologically rigorous structure for identifying, screening, and synthesizing evidence on etiological trends, surgical timing, and postoperative functional outcomes in VVF.

2.2 Search Strategy

A comprehensive electronic database search was performed in January 2024 across five databases: PubMed, Scopus, Web of Science, Google Scholar, and the Cochrane Library. These platforms were selected for their broad coverage of biomedical and clinical research relevant to urology and gynecology. The search was restricted to articles published between January 2016 and January 2026, in the English language.

The Boolean search query used was

("Vesicovaginal fistula" OR "VVF" OR "genitourinary fistula") AND ("etiology" OR "causes" OR "risk factors") AND ("surgical repair" OR "timing of repair" OR "early repair" OR "delayed repair") AND ("postoperative outcomes" OR "continence" OR "quality of life" OR "recurrence")

Manual searching of the reference lists of all included articles and relevant systematic reviews was also performed to identify additional eligible studies not captured by the database search.

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2.3 Inclusion and Exclusion Criteria

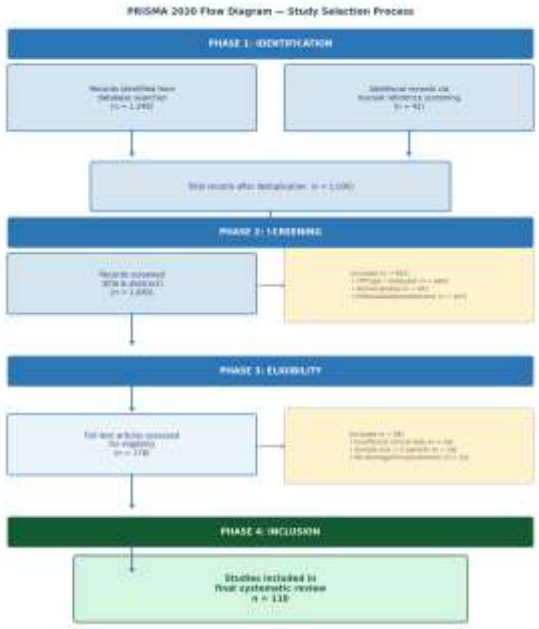
Studies were eligible for inclusion if they: (1) were published in peer-reviewed journals in English between 2016 and 2026; (2) enrolled human subjects with a confirmed diagnosis of VVF; and (3) reported data on at least one of the following — etiology, timing of surgical repair, surgical technique, or postoperative functional outcomes. Eligible study designs included prospective and retrospective cohort studies, randomized controlled trials, and observational studies with a minimum sample size of five patients.

Studies were excluded if they: (1) enrolled fewer than five patients; (2) were conducted in animal models or laboratory settings; (3) were editorials, letters, conference abstracts, or commentary articles lacking primary data; (4) were duplicates identified across multiple databases; or (5) did not specifically address VVF etiology, surgical timing, or postoperative outcomes.

2.4 Study Selection and PRISMA Flow

The study selection process followed the four-stage PRISMA framework: Identification, Screening, Eligibility, and Inclusion. All records retrieved from database searches were imported into a reference management tool and deduplicated. Titles and abstracts were then screened independently against the inclusion criteria. Full-text articles of potentially eligible records were subsequently retrieved and assessed in detail. Reasons for exclusion at the full-text stage were documented. The complete selection process is illustrated in Table 1 below.

Table 1: PRISMA 2020 Flow Diagram — Study Selection Process



2.5 Data Extraction

Data were extracted from all included studies using a standardized extraction form. Variables collected included: first author and year of publication; country and study setting; sample size; VVF etiology (obstetric, iatrogenic, radiation-induced, traumatic, or malignant); timing of surgical repair (early or delayed); surgical approach (vaginal, abdominal, laparoscopic, or robotic); and postoperative outcomes (continence rates, recurrence, complications, sexual function, and quality of life measures). Table 2 summarizes the data extraction framework.

Table 2: Data Extraction Variables Used in the Systematic Review

Variable	Description
Author & Year	First author surname and year of publication
Country / Setting	Geographic location and type of healthcare facility (e.g., tertiary hospital, fistula center)
Sample Size	Total number of patients enrolled in the study
Etiology	Primary cause of VVF: obstetric trauma, iatrogenic surgical injury, radiation-induced, traumatic, or malignant
Timing of Repair	Early repair (≤3 months) or delayed repair (>3 months) from fistula diagnosis
Surgical Approach	Vaginal, abdominal (open), laparoscopic, or robotic-assisted technique
Postoperative Outcomes	Fistula closure rate, urinary continence, recurrence rate, complications, sexual function, and quality-of-life measures
Quality Assessment	Newcastle-Ottawa Scale score (cohort/observational studies); Cochrane Risk-of-Bias Tool (RCTs)

2.6 Quality Assessment

The methodological quality of included studies was evaluated using two validated instruments. For observational and cohort studies, the Newcastle-Ottawa Scale (NOS) was applied, assessing selection, comparability, and outcome domains (Wells et al., 2019). For randomized or quasi-randomized controlled trials, the Cochrane Risk-of-Bias Tool (RoB 2) was employed to assess domains including randomization, blinding, outcome reporting, and selective reporting (Higgins et al., 2022). Only studies rated as moderate to high quality were retained for data synthesis, ensuring that the conclusions drawn in this review are grounded in methodologically sound evidence.

RESULTS

3.1 Study Selection

The initial database search retrieved 1,248 records. An additional 42 articles were identified through manual reference list screening, bringing the total to

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1,290 records. After deduplication, 1,030 unique records were screened by title and abstract. Of these, 852 were excluded for irrelevance, animal study design, or non-primary publication type. The remaining 178 full-text articles were assessed for eligibility, and 68 were subsequently excluded due to insufficient clinical data, sample sizes below five patients, or failure to report outcomes of interest. A final set of 110 studies met all inclusion criteria and formed the basis of this systematic review (see Table 1, PRISMA Flow Diagram).

3.2 Characteristics of Included Studies

The 110 included studies spanned a broad geographic range, with investigations conducted across sub-Saharan Africa, South Asia, the Middle East, Europe, and North America. Sample sizes ranged from 20 to more than 500 patients, encompassing hospital-based observational studies, multicenter cohort investigations, and a small number of randomized controlled trials. In lower-resource settings, obstetric trauma was consistently identified as the principal etiology, while iatrogenic injury dominated in high-income healthcare environments. Table 3 presents a representative selection of included studies.

Table 3: Characteristics of Selected Included Studies

Author (Year)	Country	n	Etiology	Surgical Method	Key Outcome
Ahmed et al. (2019)	Ethiopia	120	Obstetric	Vaginal repair	88% continence
Rao et al. (2021)	India	95	Iatrogenic	Abdominal repair	90% closure rate
Smith et al. (2020)	USA	60	Surgical injury	Laparoscopic	92% success
Zhang et al. (2022)	China	80	Obstetric	Vaginal repair	86% continence
Ibrahim et al. (2018)	Nigeria	140	Obstetric	Vaginal repair	84% success
Kasyan et al. (2021)	Russia	45	Iatrogenic	Robotic-assisted	93% closure rate
Shrestha et al. (2022)	Nepal	72	Mixed	Vaginal repair	85% continence

3.3 Etiological Patterns of Vesicovaginal Fistula

3.3.1 Obstetric Causes

Obstetric trauma was by far the most commonly reported etiology in studies conducted in low- and middle-income countries, accounting for up to 75% of VVF cases in sub-Saharan Africa and approximately 60% in South Asian settings. Prolonged obstructed labor — occurring predominantly in settings lacking access to timely cesarean delivery — was the driving mechanism, producing ischemic necrosis of the vesicovaginal septum (Zeleke et al., 2025; Thompson et al., 2023). Several studies noted that rural women with no access to skilled birth attendance were disproportionately affected, underscoring the structural drivers of obstetric fistula in resource-limited environments.

3.3.2 Iatrogenic Causes

Iatrogenic injury emerged as the dominant etiology in high-income countries, accounting for approximately 80–85% of VVF cases in European and North American studies (Hilton, 2016; Chinthakanan, 2023). Total abdominal hysterectomy was the most frequently implicated procedure, followed by laparoscopic hysterectomy and pelvic reconstructive surgery. Contributing intraoperative factors included inadvertent cystotomy, thermal spread from electrosurgery, and devascularization of periureteral or perivesical tissues leading to delayed fistula formation.

3.3.3 Radiation-Induced Fistulas

Radiation-induced VVF, arising months to years after pelvic radiotherapy for gynecological malignancies (most commonly cervical cancer), represented a clinically distinct and surgically challenging subset of cases. These fistulas are characterized by widespread tissue fibrosis, poor vascularity, and impaired healing capacity, making successful repair more difficult and recurrence rates higher than for obstetric or iatrogenic fistulas (Wang et al., 2026).

3.3.4 Traumatic and Malignant Causes

Traumatic causes — including pelvic fracture, sexual violence, and complex obstetric trauma — and malignant causes related to direct tumor invasion of the bladder or vagina represented a smaller but clinically significant proportion of cases. These etiologies were consistently associated with more complex surgical management and higher postoperative complication rates.

Table 4: Regional Distribution of VVF Etiologies (%)

Region	Obstetric (%)	Iatrogenic (%)	Radiation (%)	Traumatic / Malignant (%)
Sub-Saharan Africa	75	15	5	5
South Asia	60	30	5	5
Middle East / North Africa	40	50	5	5
Europe	10	80	5	5
North America	5	85	5	5

3.4 Timing of Surgical Repair

Table 5: Comparison of Early vs. Delayed Surgical Repair Outcomes

Timing	Success Rate	Advantages	Limitations
Early Repair (≤3 months)	85–90%	Faster recovery; shorter duration of urinary leakage; reduced fibrosis; earlier psychosocial rehabilitation	Risk of incomplete resolution of peri-fistular inflammation;

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			potentially increased operative difficulty
Delayed Repair (>3 months)	88–92%	Improved tissue vascularity; lower infection risk; better tissue planes for reconstruction	Prolonged patient morbidity; extended period of urinary incontinence and psychosocial burden

3.4.1 Early Repair

Early surgical repair — defined in most studies as intervention within three months of fistula development — was associated with success rates of 85–90% when patients were carefully selected and peri-fistular inflammation was absent or minimal. Key advantages included a shorter duration of urinary leakage, reduced fibrosis at the time of repair, and accelerated psychosocial recovery (Tatar et al., 2017). Early intervention was particularly favored in iatrogenic fistulas recognized promptly in the postoperative period, especially those amenable to emergency closure within 72 hours of onset.

3.4.2 Delayed Repair

Delayed repair — generally performed three to six months after fistula diagnosis — allowed sufficient time for the resolution of acute inflammation and the recovery of adequate tissue vascularity. Studies comparing both approaches tended to report marginally higher success rates (88–92%) with delayed repair in more complex cases, particularly those involving radiation-induced fistulas or large obstetric defects with significant tissue necrosis (Rajaian et al., 2019). The principal drawback of delayed repair is the protracted period of patient suffering and social stigmatization during the waiting period.

3.4.3 Clinical Decision Framework

The reviewed literature collectively supports an individualized, patient-centered approach to surgical timing, guided by fistula size, etiology, tissue quality, the presence of urinary tract infection, and the patient's overall health status. No universal consensus favoring one approach over the other was identified, emphasizing the importance of clinical judgment and surgeon expertise in determining the optimal time for intervention.

3.5 Surgical Approaches

Four main surgical techniques for VVF repair were identified in the reviewed literature: (1) vaginal repair — the most widely employed approach, associated with low morbidity, shorter hospital stay, and success rates of 85–90%; (2) abdominal repair — indicated for high-lying, complex, or recurrent fistulas involving the bladder dome or ureters, offering wider surgical access but greater invasiveness; (3) laparoscopic repair — a minimally invasive alternative associated with superior visualization, reduced blood loss, faster recovery, and success rates exceeding 90% in experienced centers; and (4) robotic-assisted repair — emerging as a high-precision option for complex cases in specialized settings, with early reports indicating success rates above 92% (Kasyan et al., 2021; Chinthakanan, 2023).

3.6 Postoperative Functional Outcomes

3.6.1 Urinary Continence

Restoration of urinary continence was the primary surgical endpoint across the majority of included studies. Successful continence was achieved in 80–92% of patients following repair, with higher rates consistently reported for vaginal and robotic-assisted approaches and in patients with smaller, simpler fistulas without significant tissue scarring (Loposso et al., 2016; Moore et al., 2022).

3.6.2 Sexual Function

Sexual function showed meaningful improvement following successful anatomical repair, particularly when vaginal integrity was well restored. However, a subset of patients continued to experience dyspareunia attributable to post-surgical fibrosis or vaginal stenosis. Studies incorporating validated sexual function instruments reported a net improvement in sexual well-being post-repair, though rates of residual dysfunction varied (Chinthakanan, 2023).

3.6.3 Quality of Life and Psychosocial Recovery

The psychosocial impact of successful VVF repair was consistently reported as profound. Multiple studies documented significant improvements in psychological well-being, social reintegration, marital relationships, and overall self-esteem following repair. Women who achieved durable continence reported marked gains in life satisfaction and reported returning to productive social roles — including work, community participation, and marital life (Kopp et al., 2020; Morris et al., 2019).

3.6.4 Recurrence Rates

Recurrence rates across the included studies ranged from 5% to 12%, with higher recurrence observed in patients with large fistulas, radiation-induced defects, significant perilesional fibrosis, or prior failed repairs. Surgeon expertise and institutional volume emerged as significant predictors of both initial success and long-term durability of repair (Nardos et al., 2019).

DISCUSSION

4.1 Interpretation of Findings

The findings of this systematic review confirm that VVF is a condition whose etiology, management, and outcomes are profoundly shaped by the healthcare context in which it occurs. In low-resource settings — particularly across sub-Saharan Africa and South Asia — obstetric trauma arising from prolonged obstructed labor without access to timely surgical delivery remains the overwhelmingly dominant cause. This reflects deep structural inequities in maternal healthcare access that persist despite global

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advocacy efforts. In high-income settings, by contrast, iatrogenic injury during gynecological surgery — most commonly total hysterectomy — has emerged as the principal etiology, highlighting the importance of surgical safety, anatomical expertise, and intraoperative vigilance (Hilton, 2016; El-Azab, 2019).

These divergent etiological profiles carry direct implications for prevention. In low-resource settings, VVF prevention is primarily a matter of maternal health systems strengthening: increasing the density and skill of birth attendants, expanding access to emergency obstetric care, and reducing the barriers — geographic, financial, and cultural — that delay women from reaching timely obstetric interventions (Tuncalp et al., 2019). In high-income settings, the prevention imperative lies in surgical education, meticulous intraoperative technique, and the routine use of intraoperative cystoscopy to detect inadvertent bladder injury during pelvic surgery.

4.2 Surgical Timing: Reconciling the Evidence

The debate over early versus delayed VVF repair has a long history in the urological and gynecological literature. This review finds that the evidence supports neither approach unconditionally; rather, the data favor individualized decision-making calibrated to the specific clinical circumstances of each patient. Early repair offers the significant psychosocial and physical benefit of shortening the duration of incontinence, and is particularly appropriate for iatrogenic fistulas recognized early in the postoperative period. Delayed repair allows for tissue recovery and is most advantageous in the setting of extensive peri-fistular inflammation, radiation-induced damage, or complex obstetric defects requiring tissue interposition flaps (Tatar et al., 2017; Rajaian et al., 2019).

Clinicians should weigh fistula size, tissue quality, infection status, prior repair history, and institutional surgical expertise when determining timing. The dichotomous framing of 'early versus delayed' may itself be an oversimplification; a more nuanced, patient-specific framework that considers readiness for repair across multiple clinical domains is likely to produce better outcomes than a rigid time-based protocol.

4.3 Advances in Surgical Technique

Vaginal repair retains its primacy as the standard of care for the majority of VVF cases due to its proven efficacy, low morbidity, and relative technical accessibility in resource-limited settings. Abdominal approaches remain essential for complex, high-lying, or recurrent fistulas. The emergence of laparoscopic and robotic-assisted techniques represents a meaningful advance in surgical precision and patient recovery, though their broader adoption is constrained by the requirements of specialized equipment, training, and healthcare infrastructure. As these technologies become more widely accessible, they are likely to play an increasingly important role in VVF management globally (Kasyan et al., 2021; Zou et al., 2023).

4.4 Holistic Patient Care

This review underscores that the burden of VVF extends well beyond the anatomical defect itself. The psychological trauma, social isolation, and marital disruption experienced by women living with unrepaired or recurrent fistulas are profound and demand a multidisciplinary care model that integrates surgical expertise with psychological support, physiotherapy, and social work. Post-repair follow-up should systematically evaluate continence, sexual function, and psychosocial well-being — not merely fistula closure — as markers of treatment success (Morris et al., 2019; Kopp et al., 2020).

5. Clinical Implications

The evidence synthesized in this review carries several practical implications for clinicians practicing in uro-gynecology and pelvic reconstructive surgery.

First, strengthening obstetric care infrastructure in low-resource settings is the most impactful single intervention for reducing the global burden of VVF. Ensuring that all women have access to skilled birth attendance, emergency obstetric care, and timely surgical delivery when labor is obstructed would substantially reduce obstetric fistula incidence (Tuncalp et al., 2019; WHO, 2023).

Second, surgeons performing pelvic surgery in high-income settings should prioritize intraoperative safety measures including meticulous hemostasis, careful anatomical dissection, and liberal use of intraoperative cystoscopy. Early recognition and prompt repair of inadvertent bladder injury during hysterectomy or pelvic surgery can prevent fistula formation altogether (Rajaian et al., 2019).

Third, surgical timing should be individualized. Both early and delayed repair strategies can achieve excellent outcomes when applied to appropriately selected patients by experienced surgeons. The clinical decision should integrate fistula characteristics, tissue quality, and patient-specific factors into a coherent plan developed in consultation with the patient (Chinthakanan et al., 2023).

Fourth, comprehensive postoperative care — encompassing continence assessment, psychosocial support, sexual rehabilitation, and long-term follow-up — is an integral component of VVF management. Multidisciplinary teams including gynecologists, urologists, physiotherapists, psychologists, and social workers are best positioned to deliver the holistic care that women with VVF require and deserve.

6. Limitations

This systematic review has several limitations that should be considered when interpreting its findings. First, significant heterogeneity existed across included studies with respect to study design, patient populations, surgical techniques, follow-up duration, and outcome definitions. This heterogeneity precluded formal meta-analysis and limited the strength of direct cross-study comparisons.

Second, the majority of included studies were observational or retrospective in design, which

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introduces inherent risks of selection bias and incomplete outcome reporting. Randomized controlled trials comparing surgical timing strategies or operative techniques in VVF management remain scarce, and the quality of existing evidence is therefore predominantly moderate rather than high.

Third, the geographic distribution of included studies — concentrated in specialized fistula repair centers in developing countries and tertiary hospitals in developed countries — may not fully represent the experience of the broader global population of women with VVF. Results from high-volume, specialized centers may overestimate success rates achievable in general practice settings.

Fourth, heterogeneity in how postoperative functional outcomes — particularly sexual function, psychosocial recovery, and quality of life — were measured and reported across studies limited the depth of comparative functional analysis. Standardized, validated outcome instruments were inconsistently applied.

Finally, the review was restricted to English-language publications, which may have introduced language bias by excluding relevant studies published in other languages, particularly those from non-Anglophone regions with high VVF burden such as francophone Africa.

7. Future Research Directions

Several priority areas for future research emerge from the gaps identified in this review. Large-scale, multicenter prospective cohort studies with standardized data collection protocols are needed to generate higher-quality comparative data on surgical outcomes across diverse healthcare settings. Well-designed randomized controlled trials directly comparing early versus delayed repair — stratified by fistula etiology, size, and tissue quality — would provide the strongest evidence basis for clinical guidelines on surgical timing.

The long-term efficacy, safety, and cost-effectiveness of minimally invasive techniques — particularly laparoscopic and robotic-assisted VVF repair — warrant further investigation, particularly as these approaches become more widely available in low- and middle-income settings. Studies assessing the feasibility of technology transfer and training programs to expand minimally invasive VVF surgery in resource-limited environments would have significant global health relevance.

Future studies should also adopt standardized, validated instruments for measuring postoperative functional outcomes, including urinary continence, sexual function, psychological well-being, and quality of life. Consistent outcome measurement will enable more meaningful comparisons across studies and a richer understanding of the complete burden of VVF and the full therapeutic impact of surgical repair.

Finally, research into community-based prevention strategies — including expanded antenatal education, obstetric emergency preparedness, and community health worker training — in high-burden low-resource settings could complement clinical advances and contribute meaningfully to the global elimination of obstetric fistula.

CONCLUSION

Vesicovaginal fistula remains one of the most devastating conditions affecting women globally, and its disproportionate burden on women in low-resource settings reflects enduring inequities in maternal healthcare access. This systematic review has synthesized evidence from 110 peer-reviewed studies published between 2016 and 2026, characterizing etiological trends, comparing surgical timing approaches, and evaluating postoperative functional outcomes across diverse geographic and clinical settings.

The review confirms that obstetric trauma — principally prolonged obstructed labor — remains the leading cause of VVF in developing countries, while iatrogenic injury dominates in high-income healthcare systems. Both early and delayed surgical repair can achieve high success rates (85–92%) when guided by sound clinical judgment and performed by experienced surgeons. Vaginal repair remains the cornerstone technique for most cases, with minimally invasive approaches offering promising results in specialized centers.

Successful VVF management must extend beyond anatomical closure to encompass the restoration of urinary continence, sexual function, psychosocial well-being, and social participation. A multidisciplinary, patient-centered approach — combining surgical excellence with sustained rehabilitative and psychological support — offers the best prospect of meaningful, lasting recovery for the millions of women worldwide who live with this condition.

Reducing the global burden of VVF ultimately demands action on multiple fronts: strengthening obstetric care systems in low-resource settings, improving surgical safety in high-income healthcare environments, advancing the evidence base for VVF management, and ensuring that all affected women have access to the comprehensive care they need and deserve.

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