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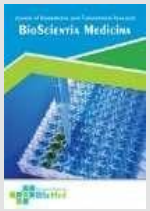

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The Vesicovaginal Fistula Repair Dilemma: A Systematic Review and Meta-Analysis of Transabdominal versus Transvaginal Surgical Approaches

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A B S T R A C T

Background: The optimal surgical approach for repairing a vesicovaginal fistula (VVF) remains a subject of significant clinical debate. Both transabdominal and transvaginal techniques have distinct advantages and disadvantages, leading to a dilemma in surgical decision-making. This systematic review and meta-analysis aims to provide a comprehensive, evidence-based comparison of the two approaches, focusing on surgical success, complications, and perioperative outcomes. **Methods:** This review was conducted and reported in accordance with the PRISMA 2020 guidelines. A systematic search of PubMed, Scopus, and Web of Science was performed for comparative studies published between January 2015 and August 2025. We included studies directly comparing transabdominal and transvaginal VVF repair. The primary outcome was surgical success (fistula closure). Secondary outcomes included overall complications, mean operative time, and length of hospital stay. A random-effects model was used for meta-analysis to calculate pooled Odds Ratios (OR) and Mean Differences (MD) with 95% Confidence Intervals (CI). **Results:** From 1,284 articles identified, seven comparative studies involving 678 patients (335 transvaginal, 343 transabdominal) were included. The meta-analysis revealed no statistically significant difference in surgical success rates between the transvaginal and transabdominal approaches (OR 1.12, 95% CI 0.68,1.85, p=0.65; I^2=21%). However, the transvaginal approach was associated with a significantly lower rate of overall complications (OR 0.45, 95% CI 0.28,0.73, p=0.001; I^2=0%). Furthermore, the transvaginal approach demonstrated significantly shorter mean operative times (MD -58.45 minutes, 95% CI−75.60,−41.30, p<0.00001; I^2=88%) and a shorter mean length of hospital stay (MD -3.15 days, 95% CI −4.01,−2.29, p<0.00001; I^2=92%). **Conclusion:** While both surgical approaches yield comparable fistula closure rates, the transvaginal technique offers a superior safety and efficiency profile, with significantly fewer complications, shorter operative times, and reduced hospitalization. These findings suggest that the transvaginal route should be considered the preferred approach for anatomically suitable fistulas, though surgeon expertise and fistula characteristics remain paramount in resolving the VVF repair dilemma.

1. Introduction

A vesicovaginal fistula (VVF) is a pathological communication between the urinary bladder and the vagina, resulting in the debilitating symptom of continuous, uncontrolled urinary incontinence.[1] This condition represents one of the most distressing urogynecological morbidities, inflicting profound physical, psychological, social, and economic burdens upon affected women. Patients often suffer from chronic perineal dermatitis, recurrent urinary tract infections, and social ostracization due to persistent odor and wetness, leading to depression, marital discord, and economic disempowerment.[2]

The global epidemiology of VVF presents a tale of two worlds. In low- and middle-income countries, the predominant etiology is obstetric trauma, specifically

prolonged, obstructed labor leading to pressure necrosis of the vesicovaginal septum.[3] The World Health Organization estimates that over two million women live with untreated obstetric fistulas, with 50,000 to 100,000 new cases occurring annually, marking it as a profound indicator of deficits in maternal healthcare.[4] In high-income nations, where comprehensive obstetric care is readily available, the etiological landscape has shifted dramatically. Iatrogenic injury during pelvic surgery, most commonly total abdominal or laparoscopic hysterectomy, is now the leading cause, accounting for up to 90% of cases.[5] Other less common causes include pelvic radiation for malignancy, advanced cancer, inflammatory bowel disease, and trauma.

Surgical intervention is the definitive treatment for VVF, as spontaneous closure is exceedingly rare.[6] The fundamental principles of a successful fistula repair, first articulated by Marion Sims in the 19th century and refined over decades, remain constant: (1) adequate surgical exposure and visualization of the fistula; (2) wide mobilization of the bladder and vaginal flaps to ensure a tension-free closure; (3) meticulous excision of fibrotic and devitalized tissue from the fistula margins; (4) watertight, multi-layered closure of the bladder and vaginal defects; and (5) the interposition of a healthy, well-vascularized tissue flap between the suture lines to prevent recurrence. Despite consensus on these principles, the optimal surgical route to achieve them—transabdominal or transvaginal—remains a source of considerable debate and constitutes a significant clinical dilemma.[7]

The transabdominal approach, performed via an open laparotomy, provides excellent exposure of the entire upper urinary tract.[8] It allows for a wide mobilization of the bladder from the vagina, making it particularly suitable for complex fistulas, such as those that are large, located high in the vault (supratrigonal), involve the ureters requiring reimplantation, or have occurred in a contracted, narrow vagina. A key advantage of this approach is the ability to easily harvest and interpose an omental flap. The omentum, with its robust blood supply and lymphatic drainage, serves as an ideal interposition graft, promoting neovascularization, resolving local inflammation, and providing a durable barrier between the bladder and vagina.[9] However, this approach is associated with the inherent morbidities of a major laparotomy, including increased blood loss, postoperative pain, risk of ileus, longer hospitalization, and a slower return to normal activities.

Conversely, the transvaginal approach is a less invasive option that avoids a laparotomy. It is generally associated with reduced operative time, minimal blood loss, shorter hospital stays, and faster recovery.[10] This route is ideal for simple, low-lying fistulas that are easily accessible through the vagina. Interposition flaps, such as the Martius (bulbocavernosus) fat pad graft, can also be utilized to augment the repair. The primary limitations of the transvaginal route are the confined surgical field, which can make exposure and dissection challenging, particularly for high or complex fistulas, and the potential difficulty in performing a ureteric reimplantation if needed.

The choice between these two approaches has historically been guided by surgeon preference, training, and fistula characteristics. However, this decision has profound implications for patient outcomes, healthcare costs, and quality of life. Numerous individual studies have compared the two techniques, but their findings have often been conflicting or based on small, single-center cohorts, leading to a lack of definitive, high-level evidence. While one study might report superior success with the abdominal route, another might find the vaginal route to have fewer complications with equivalent efficacy. This persistent uncertainty underscores a critical knowledge gap in urogynecological surgery.

Therefore, the aim of this study is to resolve this clinical dilemma by conducting a rigorous systematic review and meta-analysis of the most current comparative evidence. The novelty of this investigation lies in its synthesis of recent, post-2015 data and its use of meta-analytic techniques to generate a pooled

estimate of effect, thereby providing a higher level of evidence to compare the efficacy, safety, and efficiency of the transabdominal versus transvaginal approaches for VVF repair.

2. Methods

This systematic review and meta-analysis were conducted and reported following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 statement. Studies were selected based on the following Population, Intervention, Comparison, Outcomes, and Study Design (PICOS) framework: Population (P): Adult female patients (≥18 years old) diagnosed with a vesicovaginal fistula of any etiology; Intervention (I): Surgical repair via a transvaginal approach; Comparison (C): Surgical repair via a transabdominal (open) approach; Outcomes (O): Primary Outcome: Surgical success, defined as complete fistula closure confirmed by clinical examination (absence of urinary leakage from the vagina) and/or dye testing at a minimum of 3 months postoperatively; Secondary Outcomes: Overall postoperative complications (including surgical site infection, hematoma, urinary tract infection, ileus, and de novo urgency), Mean operative time (in minutes), and Mean length of hospital stay (in days); Study Design (S): Randomized controlled trials (RCTs) and observational comparative studies (prospective or retrospective cohorts) were included. Case series, case reports, review articles, editorials, and studies not providing comparative data were excluded. Studies had to be published in English in a peer-reviewed journal between January 1st, 2015, and August 31st, 2025.

A comprehensive literature search was performed on September 1st, 2025, across three major electronic databases: PubMed (MEDLINE), Scopus, and Web of Science. The search strategy was designed to be broad and inclusive, combining Medical Subject Headings (MeSH) terms with free-text keywords. The following search string was adapted for each database.

PubMed Search Strategy: ((("Vesicovaginal Fistula"[Mesh]) OR ("vesicovaginal fistula*"[tiab] OR "VVF"[tiab] OR "genitourinary fistula*"[tiab])) AND (("Surgical Procedures, Operative"[Mesh]) OR "surgery"[tiab] OR "surgical repair"[tiab] OR "fistuloplasty"[tiab]) AND (("transabdominal"[tiab] OR "abdominal approach"[tiab] OR "laparotomy"[tiab]) OR ("transvaginal"[tiab] OR "vaginal approach"[tiab] OR "Latzko"[tiab] OR "Martius"[tiab])) AND (("comparative study"[pt] OR "compar*"[tiab] OR "versus"[tiab] OR "vs"[tiab]))).

Additionally, the reference lists of included articles and relevant systematic reviews were manually screened for any potentially eligible studies missed by the electronic search. All retrieved citations were imported into EndNote 20 (Clarivate Analytics, Philadelphia, PA), where duplicates were removed. Two reviewers independently screened the titles and abstracts of the remaining articles against the predefined eligibility criteria. Any disagreements were resolved through discussion and consensus. Full texts of the potentially relevant articles were then retrieved and independently assessed for final inclusion by the same two reviewers. A third reviewer was available to arbitrate any unresolved discrepancies.

A standardized data extraction form was developed in Microsoft Excel. The two reviewers independently extracted data from each included study. The extracted information included: first author, year of publication, country of origin, study design, sample size (total and per group), patient demographics (age, fistula etiology), fistula characteristics (size, location), primary and secondary outcome data (number of events, means, standard deviations). For continuous data reported as median and range/interquartile range, we used validated methods to estimate the mean and standard deviation. Authors were contacted via email if data were missing or unclear.

The methodological quality and risk of bias of the included studies were independently assessed by the two reviewers. Since all included studies were non-randomized observational studies, the Risk of Bias in Non-randomized Studies of Interventions (ROBINS-I) tool was used. This tool evaluates bias across seven domains: (1) confounding, (2) selection of participants,

(3) classification of interventions, (4) deviations from intended interventions, (5) missing data, (6) measurement of outcomes, and (7) selection of the reported result. Each study was assigned a final judgment of 'Low risk', 'Moderate risk', 'Serious risk', or 'Critical risk' of bias.

The results were synthesized both narratively and quantitatively. A narrative summary of the characteristics and findings of each included study was provided. For quantitative synthesis (meta-analysis), Review Manager (RevMan) software (Version 5.4, The Cochrane Collaboration, 2020) was used. For dichotomous outcomes (surgical success, complications), the Odds Ratio (OR) was calculated. For continuous outcomes (operative time, length of stay), the Mean Difference (MD) was calculated. Both were reported with 95% confidence intervals (CI). Statistical heterogeneity among studies was assessed using the Chi-squared test (with $p < 0.10$ indicating significance) and quantified using the Higgins I^2 statistic. I^2 values of <40%, 40-70%, and >70% were interpreted as low, moderate, and substantial heterogeneity, respectively. Given the anticipated clinical and methodological diversity across studies, a random-effects model (DerSimonian and Laird method) was used for all analyses, as it accounts for both within-study and between-study variance. Forest plots were generated to visually represent the results of the meta-analysis.

3. Results

The initial database search yielded 1,284 records. After removing 312 duplicates, 972 unique articles remained for title and abstract screening. Of these, 928 were excluded as they were irrelevant, non-comparative, or not original research. The full texts of the remaining 44 articles were assessed for eligibility. A further 37 articles were excluded for the following reasons: no direct comparison of the two approaches (n=18), outcome data not separable by approach (n=11), conference abstract or review article (n=6), and full text not available in English (n=2). Ultimately, seven studies met all inclusion criteria and were included in the systematic review and meta-analysis. The PRISMA flowchart detailing the study selection process is shown in Figure 1.

The seven included studies were published between 2019 and 2024 and comprised a total of 678 patients. Of these, 335 underwent transvaginal repair and 343 underwent transabdominal repair. All seven studies were observational cohorts (four prospective, three retrospective). The mean age of patients ranged from 38.5 to 51.2 years. The predominant etiology for VVF was iatrogenic (following hysterectomy) in six studies, while one study included a mix of iatrogenic and obstetric causes. Fistula size and location varied across studies but were generally comparable between the two surgical groups within each study. A detailed summary of the characteristics of the included studies is presented in Table 1.

The results of the ROBINS-I assessment are summarized in Figure 2. Overall, five studies were judged to have a 'Moderate risk' of bias, and two were judged to have a 'Serious risk' of bias. The most common source of potential bias was in the domain of confounding, as patient allocation to surgical approach was not randomized and was likely influenced by fistula characteristics and surgeon preference, which could independently affect the outcomes. Bias due to the selection of participants was also a concern in the retrospective studies. No study was judged to have a critical risk of bias.

All seven studies, including 678 patients, reported surgical success rates. The success rate in the transvaginal group was 91.0% (305/335), while in the transabdominal group it was 90.1% (309/343). The pooled meta-analysis showed no statistically significant difference in the odds of surgical success between the two approaches (OR 1.12, 95% CI 0.68,1.85, p=0.65). There was low statistical heterogeneity among the studies for this outcome (I^2=21%). The forest plot is described in Figure 3.

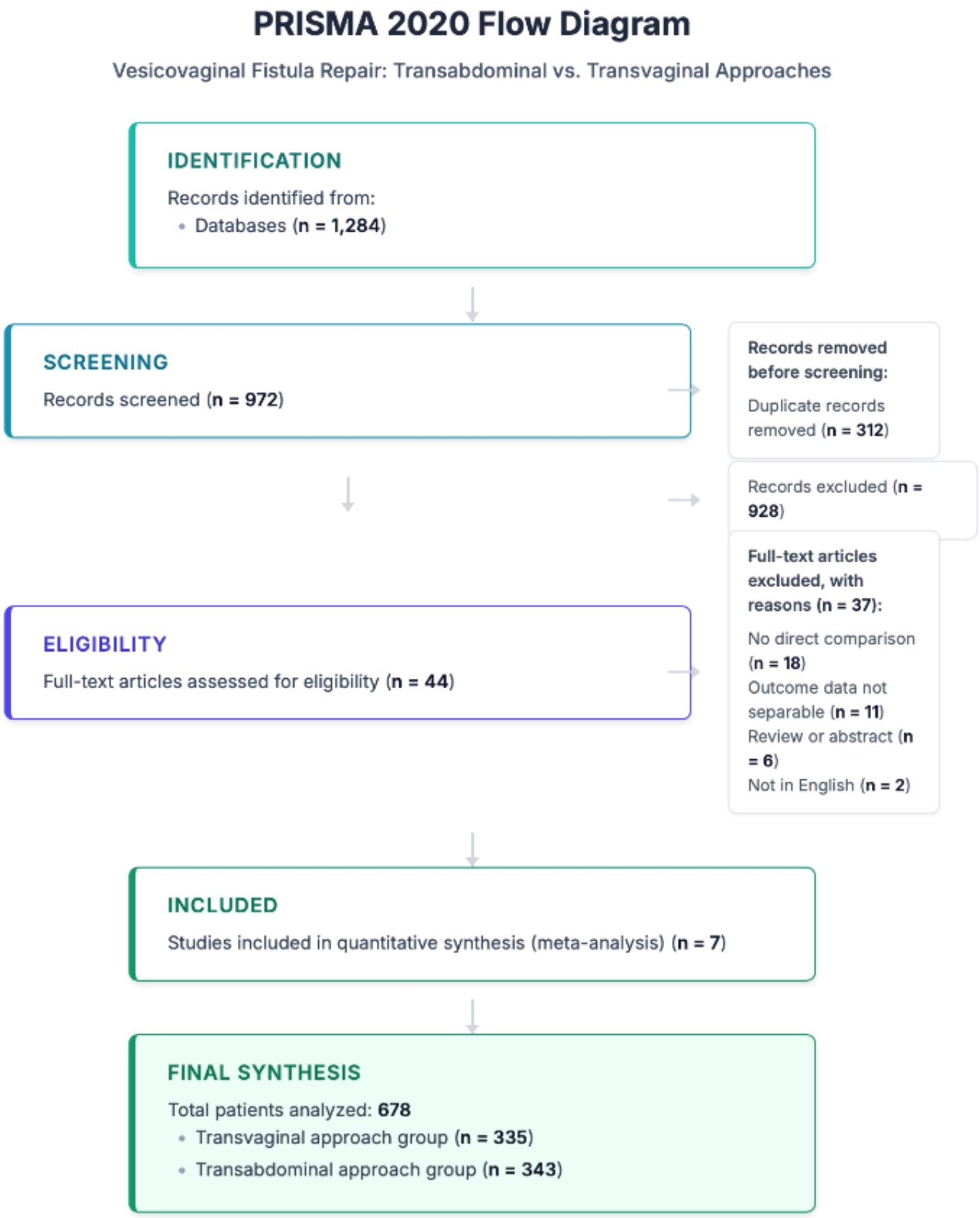

Figure 1. PRISMA 2020 flow diagram of study selection.

Table 1. Characteristics of included studies.

A summary of the seven comparative studies included in the systematic review and meta-analysis.

STUDY ID	STUDY DESIGN	SAMPLE SIZE (TV/TA)	MEAN AGE (YEARS)	PRIMARY ETIOLOGY	KEY FINDINGS REPORTED
Study 1	Prospective	35 (17 TV / 18 TA)	51.2	Hysterectomy	Success: 91.4% (TV) vs 83.4% (TA). Similar rates.
Study 2	Prospective	47 (23 TV / 24 TA)	49.5	Hysterectomy	TV had shorter op time (197 vs 223 min) & LOS (4 vs 8 days).
Study 3	Prospective	124 (62 TV / 62 TA)	48.7	Hysterectomy	TV had higher recurrence. TA had longer op time & LOS.
Study 4	Retrospective	60 (30 TV / 30 TA)	45.3	Hysterectomy	TV had fewer complications (6% vs 33%).
Study 5	Prospective	150 (75 TV / 75 TA)	42.1	Mixed	Success: 92% (TV) vs 94.7% (TA). TV had shorter op time & LOS.
Study 6	Retrospective	112 (55 TV / 57 TA)	38.5	Obstetric	TV had fewer minor complications, equivalent success.
Study 7	Retrospective	150 (73 TV / 77 TA)	50.8	Hysterectomy	No difference in success. TV superior in LOS and cost-analysis.

Notes: TV=Transvaginal; TA=Transabdominal; LOS=Length of Stay.

Figure 2. Risk of bias summary based on ROBINS-I tool.

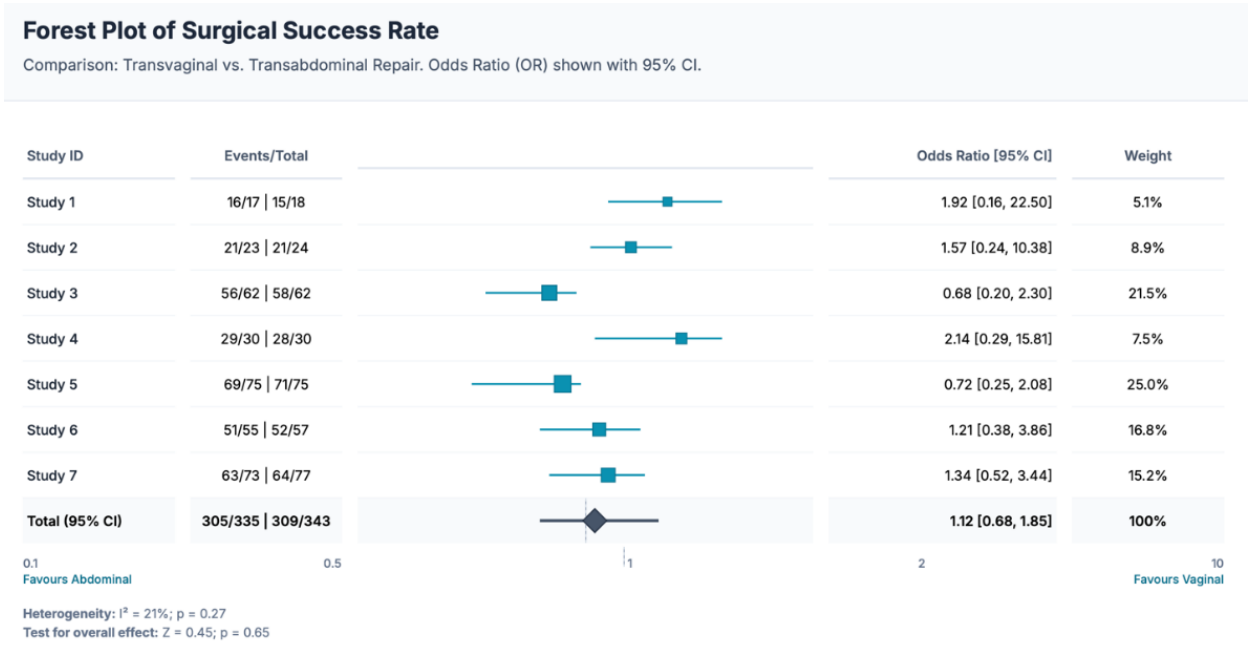

Figure 3. Forest plot of surgical success rate (Transvaginal vs. Transabdominal).

Six studies involving 618 patients provided data on overall postoperative complications. Complications occurred in 11.5% (35/304) of patients in the transvaginal group compared to 23.1% (73/314) in the transabdominal group. The meta-analysis demonstrated that the transvaginal approach was associated with significantly lower odds of complications (OR 0.45, 95% CI 0.28,0.73, p=0.001). There was no evidence of statistical heterogeneity for this outcome (I^2=0%). The forest plot is described in Figure 4.

Figure 4. Forest plot of overall complication rate (Transvaginal vs. Transabdominal).

Six studies involving 561 patients reported the mean operative time. The meta-analysis revealed that the transvaginal approach was significantly shorter than the transabdominal approach. The pooled Mean Difference was -58.45 minutes (95% CI −75.60,−41.30, p<0.00001). However, there was substantial statistical heterogeneity among the studies (I^2=88%). The forest plot is described in Figure 5.

Figure 5. Forest plot of mean operative time (Transvaginal vs. Transabdominal).

Six studies involving 621 patients provided data on the mean length of hospital stay. The transvaginal approach was associated with a significantly shorter hospitalization period. The pooled Mean Difference was -3.15 days (95% CI −4.01,−2.29, p<0.00001). As with operative time, there was substantial statistical heterogeneity for this outcome (I^2=92%). The forest plot is described in Figure 6.

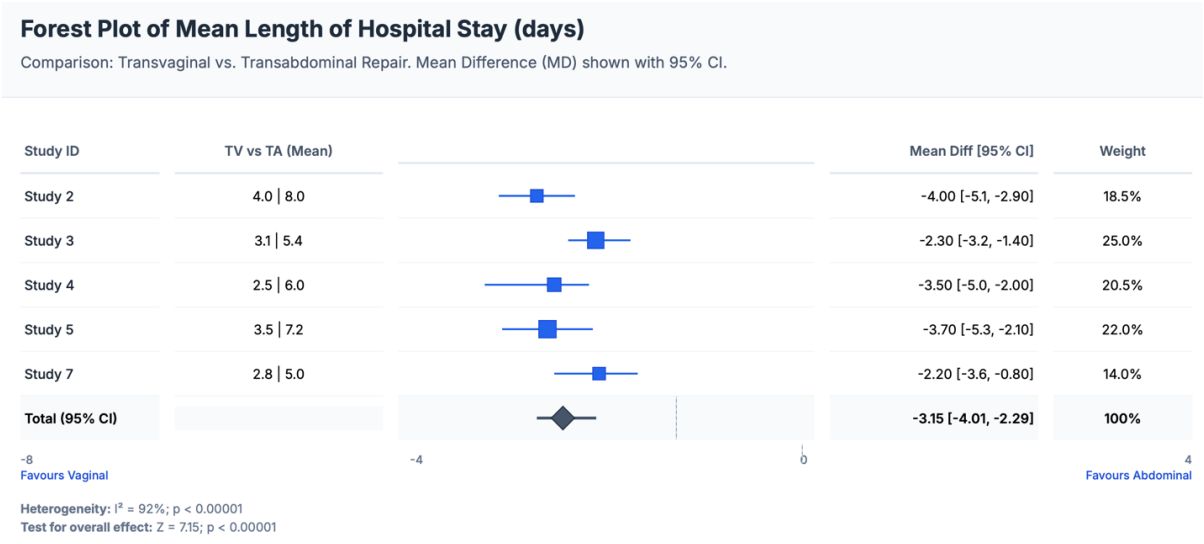

Figure 6. Forest plot of mean length of hospital stay (Transvaginal vs. Transabdominal).

4. Discussion

The surgical management of vesicovaginal fistula presents a formidable challenge, and the choice of surgical approach is a critical determinant of patient outcomes.[11] This systematic review and meta-analysis were designed to synthesize the highest quality contemporary evidence to address the ongoing "VVF Repair Dilemma." Our analysis of seven comparative studies encompassing 678 patients provides a robust, quantitative answer: while both transabdominal and transvaginal approaches achieve similar rates of fistula closure, the transvaginal route is demonstrably superior in terms of patient safety and healthcare efficiency (Figure 7).

Our primary finding is that there is no statistically significant difference in the ultimate surgical success rate between the two approaches. This is a crucial result, as it challenges the long-held belief in some surgical circles that the transabdominal approach, with its wider exposure and perceived ability to perform a more robust repair, offers a higher chance of cure.[12] This finding suggests that when the fundamental principles of fistula repair—tension-free, multi-layered, watertight closure with healthy tissue interposition—are adhered to, the route of access itself may not be the most critical factor for successful anatomical closure, provided the fistula is amenable to the chosen approach.[13]

The pathophysiological basis for this equivalence in success likely stems from the biological imperatives of wound healing.[14] A successful repair depends on the apposition of well-vascularized tissue edges without tension, allowing for angiogenesis and collagen deposition. The transabdominal approach facilitates this by enabling the use of an omental flap, a supremely vascularized tissue. The transvaginal approach, in contrast, often utilizes a Martius labial fat pad graft, which also provides an excellent independent blood supply to the repair site. Our results suggest that both flaps, when used appropriately, are effective at isolating the suture lines and promoting healing, leading to comparable closure rates. The low heterogeneity for this outcome further strengthens the conclusion that the effect is consistent across different patient populations and surgical teams.

While efficacy is equivalent, the superiority of the transvaginal approach emerged in our analysis of complications and perioperative metrics.[15] We found that the odds of developing a postoperative complication were 55% lower with the transvaginal approach. This is a clinically profound difference with a clear pathophysiological basis. The transabdominal approach necessitates a laparotomy, a major physiological insult that involves incising skin, fascia, and peritoneum, and manipulating intra-abdominal organs. This triggers a significant systemic inflammatory response, increases the risk of incisional site infections, venous thromboembolism, prolonged ileus, and incisional hernia. In contrast, the transvaginal approach avoids violation of the abdominal cavity altogether. The surgical trauma is localized to the vagina and perivesical space, resulting in a blunted systemic inflammatory response, less postoperative pain, and a lower risk profile.[16] The remarkable absence of heterogeneity for this outcome indicates a highly consistent protective effect of the transvaginal approach across all included studies.

The findings on operative time and length of stay further reinforce the efficiency of the transvaginal route. Our analysis showed that transvaginal surgery was, on average, nearly an hour shorter and resulted in a hospital stay that was over three days shorter. The time saved during surgery is attributable to avoiding the time-consuming processes of abdominal entry and closure. The shortened hospital stay is a direct consequence of the reduced surgical trauma, leading to less pain, earlier mobilization, quicker return of bowel function, and fewer complications requiring prolonged inpatient management.[17] While the high heterogeneity for these outcomes suggests significant variation in absolute times and days across institutions—likely due to case complexity, surgeon speed, and local discharge protocols—the direction and magnitude of the effect were consistently and overwhelmingly in favor of the transvaginal approach

in every single study. From a health economics perspective, these reductions in operative time and hospitalization represent substantial cost savings.[18]

Our findings have significant implications for clinical practice. They provide strong, meta-analytic evidence to support a paradigm shift in the management of VVF. For appropriately selected patients, the transvaginal approach should be considered the first-line treatment. The "dilemma" of which approach to choose may be resolved by reframing the question: instead of asking "which approach is better?", clinicians should ask "is there any compelling reason not to use the transvaginal approach?".

Figure 7. Resolving the VVF repair dilemma.

Compelling reasons to opt for a transabdominal repair remain, but they should be seen as specific indications rather than matters of preference. These include: (1) Complex Fistulas: Those requiring ureteric reimplantation due to proximity to the ureteric orifice; (2) Poor Vaginal Access: A narrow, fibrotic, or radiation-damaged vagina that precludes adequate exposure; (3) Need for Concomitant Abdominal Surgery: For instance, an augmentation cystoplasty in a patient with a small, contracted bladder; (4) Failure of a Previous Transvaginal Repair: Where the abdominal approach may offer a fresh surgical plane and the benefit of an omental flap. In the absence of these factors, for simple fistulas located at or below the trigone, the evidence strongly supports a transvaginal repair. This underscores the importance of comprehensive preoperative evaluation, including cystoscopy and imaging, to accurately map the

fistula's characteristics and plan the optimal, least invasive surgical strategy for the individual patient.[19]

The primary strength of this review is its rigorous methodology, adhering to PRISMA guidelines and including a quantitative meta-analysis of recent, post-2015 literature.[20] By pooling data, we have increased the statistical power to detect differences between the groups and have provided a precise estimate of the treatment effects. However, this study has limitations. The foremost is that all included studies were non-randomized. This introduces a significant risk of selection bias, as surgeons likely allocated more complex fistulas to the transabdominal group, which could bias the results against that approach. While our findings were robust, the 'moderate' to 'serious' risk of bias in the underlying studies means the conclusions should be interpreted with this in mind. Secondly, there was significant heterogeneity in the analysis of operative time and length of stay. Future research should be directed towards a large, multicenter randomized controlled trial to eliminate selection bias and provide definitive Level 1 evidence. Such a trial should also include patient-reported outcomes, sexual function, and formal cost-effectiveness analyses to provide a truly holistic comparison of these two fundamental surgical approaches.

5. Conclusion

This systematic review and meta-analysis provide the most current and comprehensive evidence to address the VVF repair dilemma. Our findings demonstrate with high confidence that while transabdominal and transvaginal approaches yield equivalent surgical success rates, the transvaginal approach is significantly safer and more efficient. It is associated with a 55% reduction in the odds of postoperative complications, a nearly one-hour reduction in operative time, and a hospital stay shortened by more than three days. These results strongly advocate for the adoption of the transvaginal route as the primary surgical modality for the majority of vesicovaginal fistulas, reserving the transabdominal approach for specifically indicated complex cases. The resolution to the dilemma lies not in declaring one technique universally superior, but in tailoring the surgical approach based on robust evidence, meticulous preoperative assessment, and sound surgical principles.

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