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REVIEW ARTICLE

Impact of vertical versus horizontal vaginal cuff closure on vaginal length following hysterectomy: a meta-analysis of randomized trials

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Abstract

Introduction and hypothesis Posthysterectomy vaginal length has been previously associated with postoperative sexual dysfunction, but evidence for this in the literature is controversial. The purpose of this meta-analysis was to investigate whether vertical or horizontal closure of the vaginal cuff has a direct effect on posthysterectomy vaginal length and on postoperative sexual dysfunction.

Methods The study was conducted using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We searched Medline, Scopus, Clinicaltrials.gov, EMBASE, Cochrane Central Register of Controlled Trials, and Google Scholar databases.

Results Overall, five randomized trials were included in this meta-analysis with 223 patients. The results suggest that horizontal closure of the vaginal cuff results in a shorter vaginal length compared with vertical closure [mean difference (MD) −0.77 cm, 95% confidence interval (CI) −1.12 to −0.43]. Mean vaginal length significantly decreased when the horizontal method was used (MD −0.61 cm, 95% CI −0.97 to −0.24). The subgroup analysis revealed that vertical closure was associated with longer vaginal length only in cases treated with vaginal hysterectomy. Trial sequential analysis revealed that our meta-analysis had adequate power to support these results. Postoperative sexual function was evaluated in only one study; no differences were observed.

Conclusions Findings of our meta-analysis suggest that horizontal closure of the vaginal vault results in shorter vaginal length in vaginal hysterectomies; thus, we suggest that this technique be avoided. Data concerning quality of life of patients and specifically sexual dysfunction remain extremely limited and should be studied in future trials.

Keywords Horizontal · Vertical · Vaginal cuff · Hysterectomy · Dyspareunia · Meta-analysis

Introduction

It is estimated that ~450,000 hysterectomies are performed annually in the United States according to a previous report by Wright et al. [1]. This number represents a steep decline (up to 40%) versus the number of procedures performed in 2000. Various methods of performing a hysterectomy have been described, including the vaginal procedure, traditional laparotomy, and minimally invasive procedures such as laparoscopy and robotic surgery. The actual impact of these procedures on sexual function has been previously described, and ~20% of women are estimated to experience deteriorated sexual activity directly relevant to the underlying pathophysiology [2]. Previous studies observed that women with pelvic organ prolapse (POP) increased their sexual activity by ~20%, regardless of procedure route [3, 4]. On the other hand, women with other medical conditions and who had their ovaries removed at the same time have reported problems with sexual function [5]. The procedure seems to be more hazardous when it becomes radical, e.g., for cervical cancer [6]. The impact of vaginal length in these latter procedures has been investigated, and a positive association with patient quality of life (QoL) and sexual function was observed [7].

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When surgically treating benign diseases, using the vaginal route seems to be associated with a significantly shorter vaginal length [8]. However, this effect does not seem to be clinically important, because vaginal hysterectomy seems to shorten vaginal length by only 0.63 cm [9]. Published data support this notion despite the fact that vaginal procedures tend to decrease total vaginal length (TVL) but not reduce the patient's desire for sexual activity [10]. During the last decade, several studies investigated the impact of vertical vs horizontal vaginal cuff closure on TVL. The purpose of our meta-analysis was to investigate whether the technique of vaginal cuff closure (vertical vs horizontal) significantly affects TVL and has an impact on patient QoL and specifically postoperative sexual function.

Materials and methods

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines were used during the design of this systematic review [11]. Eligibility criteria for study inclusion and their reported outcomes were predefined.

Information sources and search methods

The electronic search was based on Medline (1966–2018), Scopus (2004–2018), Clinicaltrials.gov (2008–2018), EMBASE (1980-2018), Cochrane Central Register of Controlled Trials CENTRAL (1999-2018) and Google Scholar (2004-2018) databases. Reference lists of electronically retrieved, full-text papers were reviewed to limit the possibility of potential article losses. Our search was restricted to articles published or e-published ahead of print until 30 September 2018, which was the last date of our search strategy (predefined during study design). We searched for terms horizontal, vertical, vaginal cuff, vaginal length, vagina, quality of life and sexual function; findings are presented in brief in Fig. 1.

Articles were selected in three steps. During the first step, all electronically retrieved titles were deduplicated, and two authors (VP and NT) screened the selected articles using titles and abstracts to evaluate them for inclusion. The final decision was made after reading the full text. Potential discrepancies concerning eligibility were resolved by consensus between all authors.

Types of studies and patients

Only randomized trials that assessed the impact of vertical vs horizontal cuff closure on vaginal length and sexual activity were considered as eligible for inclusion. Observational (prospective and retrospective) and animal studies and previously published reviews were excluded. We did not apply language or date restrictions during the electronic search. In case of duplicate or partially duplicate studies from the same institution and/or research team, we opted to use the most recent study providing data that could be used for quantitative synthesis.

Outcome measures

Total vaginal length and sexual function were defined as primary outcomes; complications (pain, vaginal cellulitis, vault bleeding, vault lacerations, wound disruption, bowel evisceration, wound haematoma) were considered secondary outcomes.

Quality assessment

The methodological quality of included studies was assessed with the modified Jadad scale, which uses the following criteria: description of studies as randomized and the process of randomization (one point each criterion), description of studies as double blind and details of the blinding process (one point each criterion), and information on withdrawals and allocation concealment [12]. The Cochrane risk of bias tool was also used to evaluate the possibility of selection bias (random sequence generation), detection bias (blinding of outcome assessment), performance bias (blinding of participants and personnel), attrition bias (incomplete outcome data), reporting bias (selective reporting) and other forms of potential bias.

Statistical analysis

Statistical meta-analysis was performed with the RevMan 5.1 software (Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2011). Here, 95% confidence intervals (CI) were used to describe the range of values of pooled mean differences (MD). We used the *I* square test to evaluate the extent of heterogeneity of included studies, and a p value <0.05 was defined as having statistical significance in the analysis of heterogeneity. Pooled MD and 95% CI for all primary and secondary outcomes were calculated using both the Mantel-Haenszel fixed-effects (FEM) and the DerSimonian-Laird random-effects models (REM) [13, 14]. Specifically, for all analyses, results from FEM are presented when both chi-square and I^2 statistic noted no heterogeneity between RCTs (cutoff value 50%) [15]. Results from an REM are presented when a statistically significant heterogeneity was noted. Publication bias was not assessed due to the small number of studies included in this meta-analysis [16].

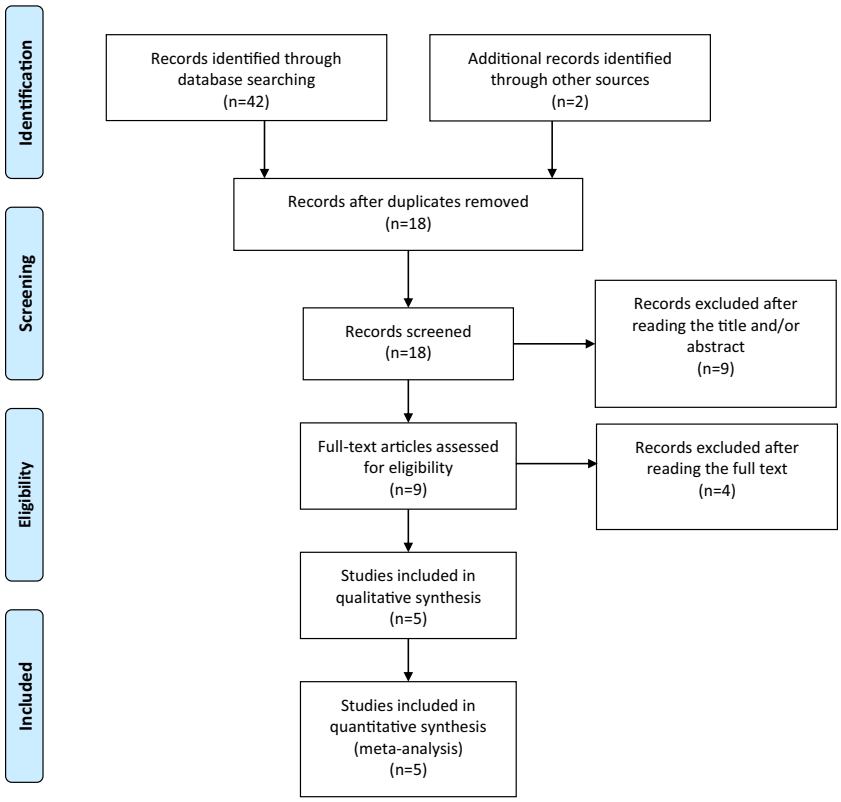

Fig. 1 Search design

Subgroup analysis

The impact of the various types of procedures was assessed by leave-one-out meta-analysis based on the route of the procedure (vaginal, laparotomy, minimally invasive).

Trial sequential analysis

Trial sequential analysis (TSA) was performed to limit the possibility of type I error. Most meta-analyses are particularly prone to this type of statistical error, which increases during repeated significance testing. TSA limits this error by using the O'Brien-Flemming alpha-spending function—an increasing function that permits adjustment of the desired statistical significance level. TSA software offers interim analyses that study the impact of each study on the overall findings of the meta-analysis. The risk for type I errors was set at 5% and for type II errors 80%. The cumulative Z-curve of the meta-analysis was plotted to define sequential boundaries to assess type I and II errors and the need for further trials in the field. We also checked whether total sample size of enrolled women reached the required information size (RIS) needed to ensure adequate power. TSA analysis was performed using v. 0.9.5.10 Beta software (http://www.ctu.dk/tsa/).

Results

Overall, five studies were included in the meta-analysis and encompassed 223 patients [17–21]. Of these, 113 were treated with horizontal sutures of the vaginal cuff and the remaining 110 with vertical sutures. The methodological characteristics of the studies are presented in Table 1. There were no cases treated with laparotomy. Most patients were treated with vaginal hysterectomy (77.5%), and 50 patients were treated with laparoscopy. No trial was blinded; at least two trials did not report the process of randomization (Figs. 2 and 3).

The meta-analysis suggests that horizontal closure of the vaginal cuff results in shorter TVL compared with vertical closure (MD −0.77 cm, 95% CI −1.12 to −0.43, outcomes from four studies, moderate heterogeneity according to the I^2-test results, Fig. 4). Mean vaginal length significantly decreased when the horizontal method was used (MD −0.61 cm, 95% CI −0.97 to −0.24, outcomes from three studies, substantial heterogeneity according to the I^2-test results, Fig. 4). Subgroup analysis revealed that vertical closure was associated with improved vaginal length only among cases treated with vaginal hysterectomy. Trial sequential analysis revealed that the meta-analysis had adequate power for both mean vaginal length postprocedure and mean reduction of vaginal length postprocedure (Supplemental Figs. 1, 2). Of note, mean vaginal length

Table 1 Methodological characteristics of included studies

Year; author	Route	Patients[a]	Inclusion criteria	Reported outcomes
2006; Vassalo	Vaginal	23 vs 20	Women with POP-Q stage 0 or 1 uterine prolapse	Total vaginal length prior to the procedure and at 6 weeks. Mean difference in total vaginal length
2014; Cavkaytar	Vaginal	26 vs 26	Women with POP-Q stage 0 or 1 uterine prolapse	Total vaginal length prior to the procedure and immediately and at 6 weeks postoperatively. Mean difference in total vaginal length
2015; Tower	Laparoscopy	5 vs 5	Women undergoing laparoscopic or robotic-assisted laparoscopic total hysterectomy for benign or malignant disease, excluding those undergoing radical hysterectomy or concomitant pelvic floor procedure	Mean difference in total vaginal length
2016; Ucar	Vaginal	41 vs 37	Women undergoing vaginal hysterectomy for stage 2 uterine prolapse	Total vaginal length prior to the procedure and at 6 weeks postoperatively. Mean difference in total vaginal length. Pre- and postoperative PISQ-12 scores. Postoperative dyspareunia and incontinence symptoms
2017; Hill	Laparoscopy	18 vs 22	Women undergoing laparoscopic or robotic-assisted laparoscopic total hysterectomy for benign or malignant disease, excluding those undergoing radical hysterectomy or concomitant pelvic floor procedure, pelvic radiation or vaginal brachytherapy, vaginal route of cuff closure	Total vaginal length prior to the procedure and immediately and at 3–4 months postoperatively. Postoperative complications and 3- to 4--months' sexual dysfunction rates

POP-Q Pelvic Organ Prolapse Quantification system, *PISQ* Pelvic Organ Prolapse/Urinary Incontinence Sexual Function Questionnaire

[a] Horizontal vs vertical

preoperatively was slightly smaller in the horizontal group, although this finding did not achieve statistical significance (MD −0.29, 95% CI −0.59 to 0.01).

Postoperative sexual function was evaluated in only one study [20]. No significant differences were observed. The authors reported that the main reason for poor sexual quality postoperatively was new-onset dyspareunia and/or incontinence. Complication rates related to the vaginal cuff suture method were reported in two studies and were restricted mainly to the early postoperative period. These included bleeding from granulated tissue, vaginal cuff cellulitis, and vaginal cuff lacerations [20, 21].

Only one study examined the degree of vaginal support postprocedure and used outcomes based on the Pelvic Organ Quantification (POP-Q) score [21]. These authors reported no differences at 3–4 months.

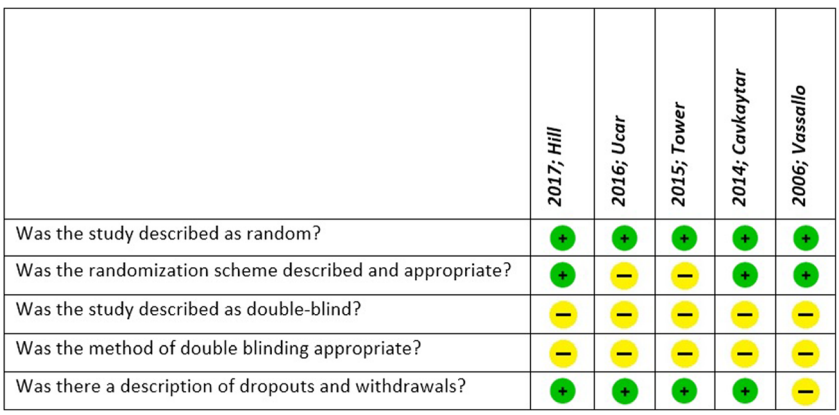

Fig. 2 Jadad scoring system

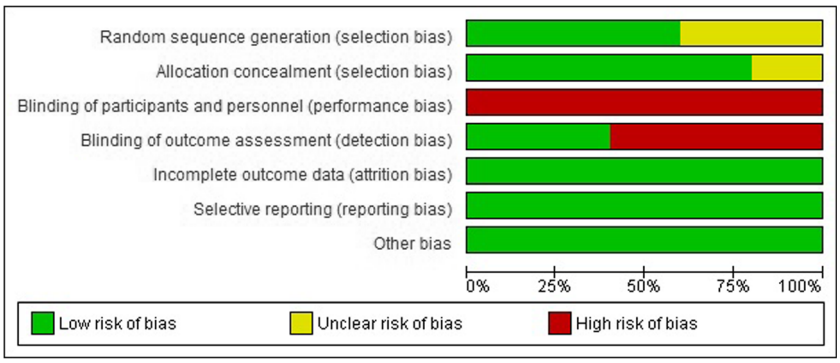

Fig. 3 Cochrane risk of bias tool

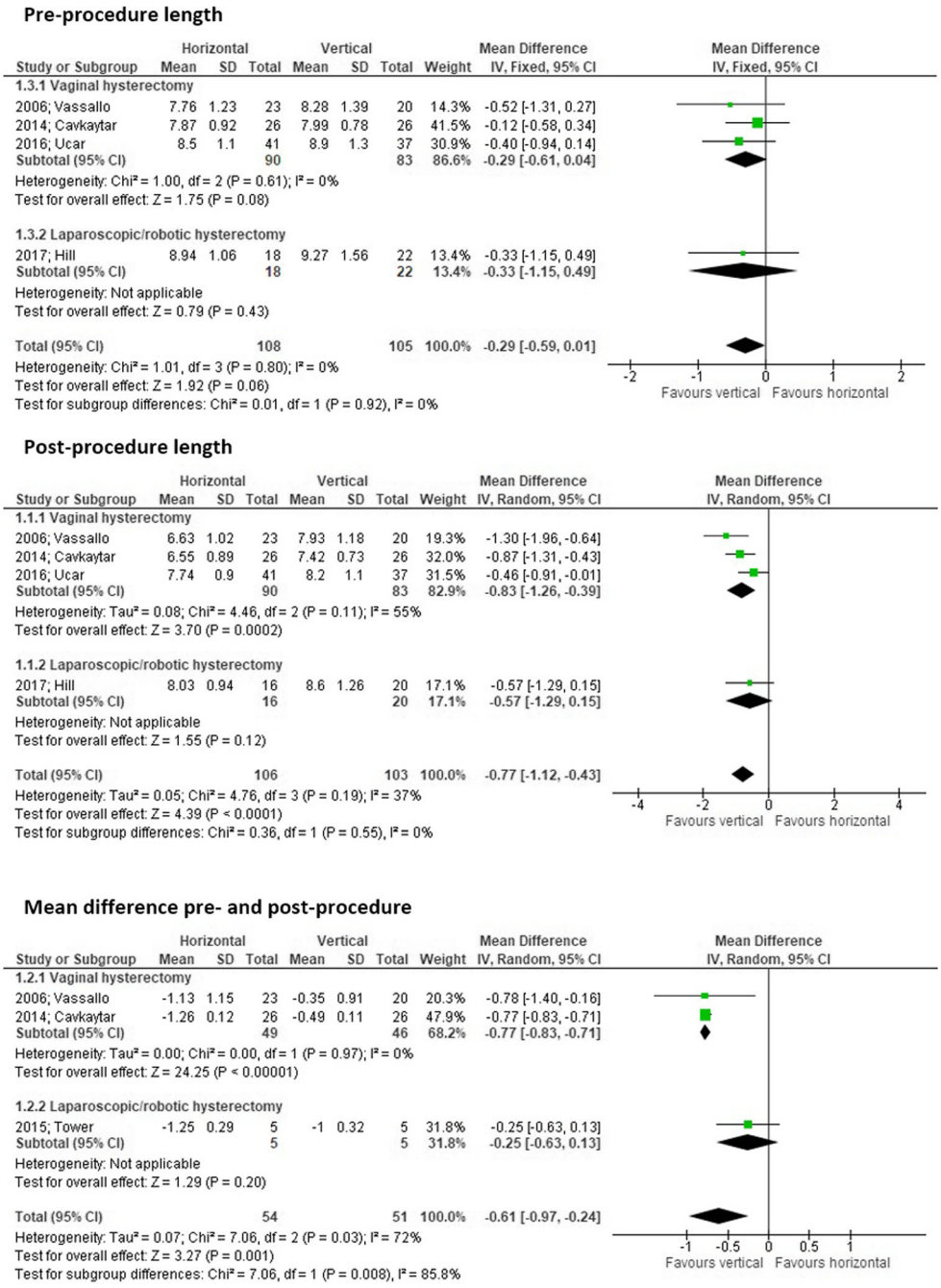

Fig. 4 Forest plots of the meta-analysis. *Vertical line*no difference point between the two regimens. *Squares* mean differences. *Diamonds* pooled mean differences for all studies. *Horizontal lines* 95% confidence interval. Results were not significant for preprocedure vaginal length ($p = 0.06$) but were significantly different for postprocedure length ($p < 0.001$) and mean difference between pre- and postprocedure length (p 0.001)

Discussion

Our meta-analysis suggests that horizontal closure of the vaginal wall is associated with shorter vaginal length versus vertical closure when the vaginal surgical route is selected. A trend toward shorter vaginal length was observed preoperatively despite the fact that all studies were randomized. This could be a potential source of bias that limits the conclusions. Furthermore, clinical significance seems to be minimal, because the MD in postprocedure length (0.77 cm) corresponds to an average decrease of about 8–10%. A potential explanation for this effect in vaginal hysterectomies may be the presence of prolapse, which could increase the length of the trimmed tissue; however, this hypothesis cannot be generalized in all cases, because the decrease in the mean cervical length was also significant when the horizontal method was used.

Evidence concerning the effect of closure type on postoperative sexual function remains extremely limited. It is difficult to safely determine whether the observed difference affects patients' QoL. The long-term effects of both techniques are also lacking, and it remains unclear whether this difference has clinical value.

Vaginal atrophy and progressive shortening TVL shortening have a clear negative impact on women's QoL [22]. During the last decade, several studies have investigated the effect of various treatment strategies on vaginal rejuvenation with the hope they will alleviate symptoms of dryness, soreness, burning and dyspareunia [23–26]. Data concerning the effect of vaginal wall closure remain extremely limited. The scarce evidence in the international literature suggests that vaginal length following vaginal hysterectomy might be an independent factor that could predict postoperative dyspareunia; thus, it is crucial to determine how this barrier can be overcome in future clinical practice [27].

In the field of minimally invasive surgery, a previous study suggested that laparoscopic surgery was associated with significantly longer vaginal wall length compared with standard laparotomy [28]. The authors reported that patients who developed dyspareunia had a significant shortening of TVL compared with those who did not; however, procedure route did not differ among groups. In our meta-analysis, vertical closure of the vaginal vault did not significantly affect TVL in patients who underwent laparoscopic/robotic surgery.

Strengths and limitations of our study

Our study was based on randomized trials that help minimize the risk of selection bias. Furthermore, trial sequential analysis revealed that results are of adequate power and for use in clinical practice, at least in the case of vaginal hysterectomies. On the other hand, data in the field of laparoscopic/robotic surgery remain limited because they are based on only two studies that recruited a relatively small number of participants. Another limitation of our study is that data concerning patient sexual function following surgery were not collected in most trials; hence, it remains unknown whether this surgical intervention might actually benefit the QoL these patients.

Implications for future research

Given that most hysterectomies are performed with traditional laparotomy [29], current evidence concerning this field remains extremely limited. Although our results suggest that the clinical significance of vertical closure of the vaginal cuff is limited, it remains unclear whether the technique would help women who have a traditional laparotomy. Moreover, this result could be significant among women treated for cervical cancer, because the radical procedure is generally associated with shorter cervical length. Data also remain extremely limited for laparoscopic procedures; further research is needed for firm conclusions in this field. In this case, it would also be useful to evaluate physician preference, because suturing is considered harder in laparoscopic surgery than in open procedures; traditionally, the vagina is closed with horizontal sutures in most cases.

It would also be helpful to evaluate the impact of the two different approaches to vaginal procedures in cases with anterior colporrhaphy for cystocele. This could assess the feasibility of the horizontal technique. Furthermore, the available evidence concerning overall QoL—especially sexual QoL—remains extremely limited. Finally, larger follow-up studies are needed to determine whether the two techniques of vaginal closure significantly affect the possibility of vaginal vault prolapse; to date, there is no such data.

Conclusion

Findings of our meta-analysis suggest that horizontal closure of the vaginal vault results in shorter vaginal length following vaginal hysterectomies; thus, this technique should be avoided until further evidence becomes available. Future studies should investigate whether horizontal closure affects patient QoL, assess rates of sexual dysfunction, and expand the follow-up period to accurately determine whether this effect has clinical significance in menopause given that progression of vaginal atrophy is likely in this stage.

Compliance with ethical standards

Conflicts of interest None.

Research involving human participants and/or animals This systematic review and meta-analysis are based on previously published aggregated data.

Institutional review board approval An IRB approval was not needed because this study used previously published aggregated data.

Informed consent Formal consent is not required for this type of study.

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