

ORIGINAL ARTICLE

OUTCOME OF VAGINAL CUFF CLOSURE FOLLOWING TOTAL LAPAROSCOPIC HYSTERECTOMY USING UNIDIRECTIONAL BARBED SUTURE VERSUS VAGINAL APPROACH FOR BENIGN UTERINE CONDITIONS

Adil Bangash, Ayaz Gul, Ahmad Faraz, Nargis Gulab

Department of General Surgery, MTI , Lady Reading Hospital Peshawar, KPK, Pakistan

ABSTRACT

Background: Multiple factors influence the outcome following a vaginal cuff closure such as the use of instruments for the intracorporeal suturing, the skill of the surgeon and more importantly the indication for surgery and pre-existing factors such as diabetes, obesity and smoking. The objective of this study was to compare intra-operative vaginal cuff closure following total laparoscopic hysterectomy using unidirectional barbed suture or vaginal approach, for benign uterine conditions.

Materials & Methods: It was a prospective interventional study conducted at obstetrics and gynecology department of northwest general hospital and Lady Reading Hospital Department of Surgery from 1st January 2018 till 31 December 2022. All patients presenting to Out-patient department with benign pathology and needing laparoscopic surgery were put alternatively in two groups. A total of 84 patients were included in this study 42 in each group. Group A included patients where hysterectomy was performed laparoscopically and uterus was delivered vaginally followed by closure of the vault over the manipulator in continuous fashion with PDS 2/0 or Vicryl V-Lock[®] (Covidien). In Group B the Uterine Manipulator was removed and vaginal closure was performed in two layers bidirectionally using Vicryl 2/0. Data was collected, placed on SPSS version 16. and was analyzed.

Results: Eighty four (84) patients were subjected to TLH and were alternately placed in to either Group A or B. The mean age and BMI of patients were similar with no statistical differences. The most frequent indication for Hysterectomy in both groups was Fibroid uterus. Eighteen patients (43.9%) from Group A and 21 patients (51.2%) from group B were post-menopausal. Lower operative times was observed in Group B with a mean difference in operative times of approximately 27 minutes was observed ranged between 39.5 and 118.5 minute. Vaginal cuff hematoma was observed more frequently in group A (4 patients). In contrast only two patients (4.8%) from group B had evidence of small hematomas.

Conclusion: There is a non-significant difference with Regards to Mean operating time following Laparoscopic Hysterectomy with lesser time taken for Vaginal Cuff repair vaginally as compared to Laparoscopic repair. There is no difference in outcomes between groups for the choice of material used except that the incidence of Vaginal Dehiscence was higher in patients with Laparoscopic repair (Barbed suture Single Layer Continuous Repair).

KEY WORDS: Total laparoscopic hysterectomy; Vaginal cuff repair; Unidirectional barbed suture.

Cite as: Bangash A, Gul A, Faraz A, Gulab N. Outcome of vaginal cuff closure following total laparoscopic hysterectomy using unidirectional barbed suture versus vaginal approach for benign uterine conditions. Gomal J Med Sci 2024 Apr-Jun;22(2):120-26. <https://doi.org/1046903/gjms/22.02.1597>

Corresponding Author:

Dr. Ahmad Faraz
Assistant professor & HOD
Department of surgery
Lady reading Hospital
Peshawar, Pakistan

E-mail: drahmadfaraz79@gmail.com

Date Submitted: 09-07-2023

Date Revised: 11-02-2024

Date Accepted: 01-03-2024

INTRODUCTION

Henry Reich performed the first Laparoscopic Hysterectomy in 1989 and since then several techniques have emphasized on the various approaches and modifications to enroll patients as potential candidate for Laparoscopic and minimally invasive procedures.

¹ Many proponents of Vaginal Hysterectomy strongly recommend vaginal hysterectomy for non-prolapse benign indications.^{2,3} Recently, a multivariate analysis conducted by Lee et al. concluded the benefits of vaginal hysterectomy in a large series of 1618

patients, depicting reduced operative times and fewer complications when compared with different techniques of laparoscopic hysterectomy.⁴

Overlooking the benefits of reduced postoperative bleeding and earlier resumption to normal activities alongside lower mean pain scores clearly outlines the benefits of laparoscopic hysterectomy. Inevitably, with the range of indications for hysterectomy and gynecologists still prefer the vaginal route but there remains much debate about the choice and technique of Vaginal cuff closure at the end of a Laparoscopic Hysterectomy.⁵ Debate about completing most of the later steps of hysterectomy by the Laparoscopic Assisted Vaginal Hysterectomy (LAVH) was surging literature with widely contrasting results suggesting the feasibility of repairing the Vaginal cuff by the vaginal route rather than unidirectional or bidirectional suture intracorporeally at the end of a Total Laparoscopic Hysterectomy.⁶⁻⁸

The importance of this debate ranks from the fear of a dreadful complication known as vaginal cuff dehiscence, which could result in Visceral perforation and life-threatening bleeding in an infected environment.⁹ The incidence of vaginal cuff dehiscence is reported to be 5-10 times more frequent than the very low 0.1%-0.2% following vaginal or open abdominal hysterectomy.¹⁰ Thus, the triad of Infection, bleeding and dehiscence remains the primary focus of deciding the technique of closure.

Multiple factors influence the outcome following a vaginal cuff closure such as the use of instruments for the intracorporeal suturing, the skill of the surgeon and more importantly the indication for surgery and pre-existing factors such as diabetes, obesity and smoking.¹¹⁻¹³ Vaginal anatomy related to age and post-operative coital activity are other important factors that influence outcomes after a vaginal cuff repair.

Most studies have focused on data retrieved from document of patients retrospectively and there are few studies that have prospectively evaluated the two approaches with wide variation in the choice of suture material, the technique of suturing (continuous vs interrupted) and the distance from the cuff edge or adjacent sutures. The objective of this study was to determine which approach is feasible with regards to operative time and frequency of complications.

MATERIALS AND METHODS

This prospective interventional (experimental) trial was conducted at Northwest general Hospital and Lady Reading Hospital, following Ethical Approval from the committee for Biomedical Ethics at Lady Reading Hospital, Peshawar. A consent form carrying details of the type of procedure and its details were clearly enlisted to obtain Informed consent from every patient was obtained. Surgeons included to operate in the study with a minimum experience

of 50 Total Laparoscopic Hysterectomies (TLH) were questioned by the researcher about their experiences with suturing techniques at the end of the procedure.

In a study conducted by Uccella et al. the incidence of Postoperative Vaginal cuff bleeding was 2.7%.¹⁴ considering a margin of error of 5% and a confidence interval of 95% the calculated number of patients in each group of the study accounts to 41 cases summing to a total of 82 patients that are to be operated for benign uterine diseases.

From 1st January 2018 till 31st December, 2022 all patients presenting in the Out-patient Department following complete workup, that were candidates for Elective Laparoscopic Hysterectomy with Benign conditions, were enrolled and alternately placed in either group by purposive (convenience) method. Inclusion criteria was all patients of all age groups with diagnoses of benign uterine conditions without history of any open pelvic surgery were included in the study. Patients with NYHA grade 3 and 4, previous pelvic surgery, clinically evident prolapse and suspicion or proven malignancy were excluded. Per-operatively, any patient with suspicion of malignancy were subjected to histopathological confirmation, if not previously excluded from the study. In case results of histopathology guided a diagnosis of Malignancy; those patients were excluded from the study.

All patients were subjected to complete obstetrical and gynecological history followed by complete work-up including hematological, serological and biochemical workup. Patients with a hemoglobin concentration of 10g/dl were subjected to Iron therapy or transfusions guided by the Ferritin levels. In the theatre, all patients were placed in a standard lithotomy position or Lloyd Davies position on the direction of the operating surgeon. Mangeshkar Uterine manipulator was first positioned and a standard three to four port laparoscopic access was established with the camera port of 10mm universally placed at the umbilicus. The vessel sealing device used in all cases was Ligasure^R (LS10).

Following the procedure till completion when the uterus was delivered vaginally, in Group A the vaginal Vault was repaired laparoscopically over the uterine Manipulator. Change in size of the manipulator during closure in group A was permitted to ensure adequate closure and Single layer continuous Closure with 2/0 PDS or Vicryl V-Lock^R (Covidien) was fashioned. In Group B the Uterine Manipulator was removed and vaginal closure was performed in two layers bidirectionally using Vicryl 2/0. In this group the ports were not removed till completion of closure. At the end of the procedure in both groups' Laparoscopic inspection of complete anterior and posterior walls of the stump were examined to observe completion of closure. In case

of defects (inadequate closure) additional sutures were permitted in both groups.

Pelvic drains were placed in the pelvis in both groups and only external padding around the perineum was done before shifting the patient to the Recovery area. Intake and output monitoring was done in all patients during the first 24 hours and at the end of first POD drains and Padding was checked for documenting additional bleeding in the post-operative phase. General complications such as atelectasis, fever, Deep venous thrombosis and paralytic ileus were documented on the proforma as were surgical complications, which included bleeding, vaginal discharge, wound infection, Vaginal Stump dehiscence, Postoperative Hospital stay and pain scores on 1st Post-operative Day. Post-operative weight of delivered uterus and Operative time considered as the time of trocar insertion till removal of all ports at the end of the procedure was calculated.

Data collection was done by the researcher in this study and the operating surgeons were blinded of the inclusion of any patient in a particular group till the closure in the operating theatre. All patients were counselled and advised to avoid intercourse for 8 weeks. The patients were followed in the out-patient department at 10 days and one month post-operatively.

Statistical Analysis

All data from file and proforma were recorded on the SPSS version 16. Demographic data, operative data and complications of both groups were compared with a *p* value of 0.05 considered at statistically significant. Continuous data such as age, hospital stay, blood loss and operative time were represented as mean, \pm standard deviation and groups were compared using the student t test and Mann Whitney U test. Categorical data was represented as percentage and compared with the other group using the Chi square test.

RESULTS

During the duration of the study 103 patients were subjected to Total Laparoscopic Hysterectomy (TLH). For benign conditions of the uterus, 84 patients were subjected to TLH and were alternately placed in to either Group A or B. One patient from either group was lost during follow-up and were excluded from the study. The mean age and BMI of patients were similar with no statistical differences. The most frequent indication for Hysterectomy in both groups was Fibroid uterus with ultrasonological evidence of less than size of equivalent 12 weeks gravid uterus prior to surgery. (*p*=0.55)

Preoperative focus on patient factors such as Hemoglobin (*p*=0.49) and Ferritin levels (*p*=0.37) was maintained to rule out indication for transfusion in the post-operative period and the observation of

these non-significant findings were also augmented by the fact that patients with low ferritin levels were first subjected to Iron therapy and those with normal Ferritin and transferrin levels were advised pre-operative blood transfusions before surgery till hemoglobin levels and anemia normalized. Three patients (7.3%) from group A and one patient (2.4%) from group B required pre-operative transfusions to progress to surgery.

Two patients (4.8%) from Group A had recent exposure or history of corticosteroid therapy for other causes. Liaison with the anesthetist about requirement for per-operative doses of Hydrocortisone was decided based on 9 am cortisol readings. A total of 14 patients (17%) from the series were diabetic at the time of surgery with 8 patients (19.5%) from Group A, these findings were statistically non-significant (*p*=0.33). Most patients in the series were sexually active and married although 18 patients (43.9%) from Group A and 21 patients (51.2%) from group B were post-menopausal. (*p*=0.62)(Table 1)

A non-significant difference of lower operative times was observed in Group B with a mean difference in operative times of approximately 27 minutes was observed ranged between 39.5 and 118.5 min (*p*=0.06). The per-operative mean weight of uteri in Group A was larger (285g) than those of Group B (256.6g) but this difference was not statistically significant (*p*=0.83). The recorded operative Blood loss was non-significantly higher in the Vaginal repair group with a mean blood loss of 118 ml but no patient from either group was transfused blood per-operatively.

Vaginal cuff hematoma was observed more frequently in group A (4 patients) and these finding were observed during surgery laparoscopically during the repair or at the end of the procedure. In contrast only two patients (4.8%) from group B had evidence of small hematomas at the end of the procedure when examined laparoscopically before termination of the procedure. The hematoma was invariably observed at the corners of the vaginal cuff repair and two patients (4.8%) from Group A whereas one patient (2.4%) from Group B required open exploration to drain the hematomas and secure hemostasis.

The other cause for conversions was one patient (2.4%) from Group A with suspected bowel injury in a case of endometriosis and another conversion was performed in a patient from Group B with evident ureteric injury with complete transection at the level of the Mackenrod's ligament along with bladder injury in a case of severe adhesions from Endometriosis. (*p*=0.18) (Table 2)

The mean amount of blood collected in drains post-operatively was similar in both groups with no significant statistical difference as was the number of patients in either group requiring blood transfusion post-operatively. Minimal collections detected by UI-

Table 1. Demographic and Preoperative Data (n=41)

	Group A (Laparoscopic repair) n=41	Group B (Vaginal repair) n=41	Significance p=
Age (yrs)(mean) (\pm s.d)	49.9(+6.1)	51.4(+5.9)	0.9
BMI (Mean)(\pm s.d)	24.3(+3.6)	22.8(+4.1)	0.52
Parity (mean) (\pm s.d)	3.1(+1.1)	2.8(+0.9)	0.67
Indication for surgery			
Fibroid uterus (%)	07(17%)	06(14.6%)	0.55
Dysfunctional uterine bleeding (%)	14(34.1%)	15(36.5%)	
Endometrial Hyperplasia (%)	08(19.5%)	06(14.6%)	
Adenomyosis (%)	04(9.7%)	02(4.8%)	
Endometrial polyp (%)	02(4.8%)	05(12.1%)	
Endometriosis (%)	02(4.8%)	01(2.4%)	
Ovulatory dysfunction (%)	04(9.7%)	06(14.6%)	
Pre-operative Hemoglobin (g/dl) (\pm s.d)	10.3(+1.8)	11.1(+2.2)	0.49
Ferritin Levels (ng/ml) (\pm s.d)	118.6(19.1)	131.6(+23.9)	0.37
Diabetes (%)	08(19.5%)	06(14.6%)	0.33
Corticosteroid administration (%)	02(4.8%)	00	0.18
Post-menopausal status (%)	18(43.9%)	21(51.2%)	0.62

2. Per-operative Data and operative complications (n=41)

	Group A (Laparoscopic repair) n=41	Group B (Vaginal Repair) n=41	Significance p=
Mean Operative time (min) (\pm s.d)	124.9(38.1)	97.3(18.4)	0.06
Weight of the uterus (g)(\pm s.d)	285(+63.3)	256.6(+78.1)	0.83
Mean Operative Blood Loss (ml) (\pm s.d)	93.2(31.6)	118(+59.5)	0.14
Vaginal Cuff Hematoma (%)	04(9.7%)	02(4.8%)	0.2
Ureteric injury (%)	01(2.4%)	01(2.4%)	0.71
Bowel injury (%)	02(4.8%)	00	0.09
Urinary bladder injury (%)	01(2.4%)	03(7.3%)	0.14
Conversion to open abdominal procedure (%)	03(7.3%)	02(4.8%)	0.18

trasond was observed in three patients (7.3%) from group A and 2 patients (4.8%) from Group B. Two patients (4.8%) from Group A required radiological drainage after Total laparoscopic hysterectomy for pelvic collections and associated high grade pyrexia not settling with antibiotics after one week. One patient (2.4%) from Group B that was converted to open surgery to repair ureteric and bladder injury required radiological drainage of a urinoma. During the follow-up Period, two patients (4.8%) from

Group A that had early post-operative complaints of vaginal bleeding, presented with vaginal Dehiscence when examined on 10th post-operative day. One (2.4%) of the two patients had suspicion of gut loops protruding through the defect on speculum examination which required urgent intervention by reduction of bowel loops and repair of the vaginal vault/cuff through the vaginal route. Mean stay of patients was very similar ranging from 1day to 12 days in both groups (p=0.81). (Table 3)

Table 3. Frequency of General/Vaginal cuff Complications and Postoperative Outcome

	Group A (Laparoscopic repair) n=41	Group B (Vaginal Repair) n=41	Significance p=
Mean Post-operative blood loss(ml) (\pm s.d)	110.8(+47.5)	106.3(+56.1)	0.88
Vaginal Bleeding (%)	02(4.8%)	01(2.4%)	0.51
Post-operative pyrexia (%)	04(9.7%)	03(7.3%)	0.39
Intra-abdominal collection (%)	03(7.3%)	02(4.8%)	0.44
Urological injury/fistula (%)	04(9.7%)	04(9.7%)	0.89
Vaginal Dehiscence (%)	02(4.8%)	00	0.09
Vaginal Evisceration (%)	01(2.4%)	00	0.23
Paralytic ileus (%)	02(4.8%)	03(7.3%)	0.61
Port site infection (%)	02(4.8%)	03(7.3%)	0.61
Pulmonary complications (%)	04(9.7%)	01(2.4%)	0.29
Deep venous thrombosis (%)	01(2.4%)	00	0.23
Requiring Re-operation/Re-intervention (%)	04(9.7%)	01(2.4%)	0.19
Mean Post-operative Stay (Days) (\pm s.d)	2.8(+0.9)	2.6(+0.7)	0.81
Mean Pain score 1 st postoperative day(\pm s.d)	4.6(+2.1)	5.1(+1.8)	0.78
No. of cases requiring blood transfusion (%)	02(4.8%)	02(4.8%)	0.8

DISCUSSION

Hysterectomy is a very common gynecological procedure that has many fears associated with the complications and outcomes varying according to the indication for Hysterectomy. Since the introduction of Laparoscopic Hysterectomy there has been many variations described due to the learning curve of intracorporeal suturing of the vaginal cuff at the end of hysterectomy.^{15, 16} Knowing the benefits of laparoscopic surgery with reduced bleeding or need for transfusions, reduced hospital stays and early resumption to normal activity, there remains concerns about the number of urological injuries, the operative times and complications of anesthesia.^{17, 18}

In a study conducted by Uccella et al. which included a large number of prospectively enrolled patients, the incidence of vaginal cuff complications was much higher in the Transvaginal repair group¹⁴. With cuff complications accounting to 19.5% in the transvaginal group and particularly vaginal cuff dehiscence being 2.7% in comparison to 1% in the intracorporeal unidirectional Barbed wire laparoscopic group, suggested that the study be concluded and stopped due to ethical issues (p=0.01). This was not observed in our study as only two patients had presented with vaginal dehiscence. In our study the number of subjects were much fewer than included in the study by Uccello et al. but surgeons were permitted to have a final laparoscopic loo after both techniques of closure and in cases of doubt, were allowed to take

additional sutures.

Perfecting the art of intracorporeal suturing with conventional suture has remained a major challenge for many laparoscopic gynecologists and a 4 port has many ergonomic limitations.¹⁹ But the introduction of the barbed suture has significantly improved operating times and reduced the chances of defects. In our study the vaginal repair Group (Group B) was performed with Vicryl 2/0 (interrupted) which suggests the slight but obvious increase in the suture cost but this is not significant considering the additional cost of Rs. 2500-5000/-. In a study conducted by O'Hanlan et al. there is a clear contradiction to the results following vaginal closure after Laparoscopic Hysterectomy, with very low rates of Vaginal cuff complications (2.29%) and a vaginal dehiscence rate of less than 1%.²⁰ The technique described by O'Hanlan et al, incorporates 5mm deep vaginal sutures at 5mm distance. Whereas in our study the additional placement of sutures and Laparoscopic vision at the end of the procedure augments the repair.

In a study conducted by Blikkendaal et al. three techniques were compared which included 75 repairs (22.7%) performed transvaginally (interrupted), 90 repairs (27.2%) performed in the interrupted fashion laparoscopically and the laparoscopic continuous single layer suture used in 166 patients (50.2%).²¹ The frequency of vaginal dehiscence was observed in 1.3%,3.3% and 2.4% respectively. Suggesting a more comparable result for the interrupted vaginal

repair and a continuous single layer laparoscopic approach to repair of the Vaginal cuff at the end of Laparoscopic Hysterectomy. This study had many similarities in methods to our study except that in our study the Laparoscopic repair (group A) was performed using V-lock 2/0 making it easier to use. In a study conducted by Herraiz et al. the efficacy of barbed suture (V-Lock) was observed in a series of 121 laparoscopic hysterectomies only one case (0.8%) of partial vaginal dehiscence was observed using uni or bi-directional laparoscopic vaginal cuff repair. In our study two patients (4.8%) had presented with Vaginal cuff dehiscence in the Laparoscopic repair Arm using V-lock sutures.²² In their study, 3.3% patients had Pyrexia or post-operative abscess/ collection in the pelvis which is comparable to the 4.8% from our study.

The highlight of our study was the operative time which was statistically non-significant but the results are comparable to results from most studies although the discussion on the laparoscopic techniques and skills of surgeons varies widely.²³ In a retrospective observational study conducted by Kim et al. the mean time taken alone for Laparoscopic closure of the vaginal cuff was 7.4min in the barbed wire group versus the Vicryl group (12.2 min) which was statistically significant ($p=0.001$).²⁴ The number of patients in our study were fewer than most studies concluding the benefits of a laparoscopic repair of the vaginal cuff after laparoscopic hysterectomy. In our study the various techniques of repair were limited. Alone supporting the results of lower but insignificant total operative times of vaginal repairs could be a major limitation before deciding which procedure is of choice to proceed at the end of a laparoscopic Hysterectomy.

CONCLUSION

There is a non-significant difference with Regards to Mean operating time following Laparoscopic Hysterectomy with lesser time taken for Vaginal Cuff repair vaginally as compared to Laparoscopic repair. There is no difference in outcomes between groups for the choice of material used except that the incidence of Vaginal Dehiscence was higher in patients with Laparoscopic repair (Barbed suture Single Layer Continuous Repair). A multi-center Randomized controlled trial comparing other modifications, techniques and suture materials for closure of vaginal cuff after Laparoscopic Hysterectomy need to be performed; focusing on larger number of patients.

REFERENCES

1. Reich H, DiCaprio J, McGlynn F. Laparoscopic hysterectomy. *J Gynecol Surg.* 1989;5:213-216. <https://doi.org/10.1089/gyn.1989.5.213>
2. Desai VB, Guo XM, Fan L, Wright JD, Xu X. Inpatient laparoscopic hysterectomy in the United States: trends and factors associated with approach selection. *J Minim Invasive Gynecol.* 2017;24:151-8. <https://doi.org/10.1016/j.jmig.2016.08.830>
3. Park YS. Current trends of gynecologic surgery in the 21st century: scarless surgery. *Korean J Gynecol Endosc Minim Invasive Surg.* 2010;22:69-89. <https://doi.org/10.7602/jmis.2019.22.2.69>
4. Lee SH, Oh SR, Cho YJ, Han M, Park JW, Kim SJ, et al. Comparison of vaginal hysterectomy and laparoscopic hysterectomy: a systematic review and meta-analysis. *BMC Women's Health* 2019;19: 83. <https://doi.org/10.1186/s12905-019-0784-4>
5. Shin JW, Lee HH, Lee SP, Park CY. Total laparoscopic hysterectomy and laparoscopy-assisted vaginal hysterectomy. *JLS.* 2011;15(2):218-221. <https://doi.org/10.4293/108680811X13071180406394>
6. Bogliolo S, Nadalini C, Iacobone AD, Musacchi V, Carus AP. Vaginal cuff closure with absorbable bi-directional barbed suture during total laparoscopic hysterectomy. *Eur J Obstet Gynecol Reprod Biol.* 2013;170:219-221. <https://doi.org/10.1016/j.ejogrb.2013.06.006>
7. Greenberg JA. The use of barbed sutures in obstetrics and gynecology. *Rev Obstet Gynecol.* 2010;3:82-91.
8. Greenberg JA, Einarsson JI. The use of bidirectional barbed suture in laparoscopic myomectomy and total laparoscopic hysterectomy. *J Minim Invasive Gynecol.* 2008;15:621-3. <https://doi.org/10.1016/j.jmig.2008.06.004>
9. Park D, Jeong H. Vaginal vault evisceration after total laparoscopic hysterectomy. *Korean J Gynecol Endosc Minim Invasive Surg.* 2012;24:120-126.
10. Siedhoff MT, Yunker AC, Steege JF Decreased incidence of vaginal cuff dehiscence after laparoscopic closure with bidirectional barbed suture.. *J Minim Invasive Gynecol.* 2011;18:218-223. <https://doi.org/10.1016/j.jmig.2011.01.002>
11. Fanning J, Kesterson J, Davies M, Green J, Penezic L, Vargas R, et al. Effects of electro-surgery and vaginal closure technique on postoperative vaginal cuff dehiscence. *JLS.* 2013;17:414-417. <https://doi.org/10.4293/10860813X13693422518515>
12. Croce E, Olmi S. Intracorporeal knot-tying and suturing techniques in laparoscopic surgery: technical details. *JLS.* 2000;4:17-22.
13. Weizman NF, Manoucheri E, Vitonis AF, Hicks GJ, Einarsson JI, Cohen SL. Design and validation of a novel assessment tool for laparoscopic suturing of the vaginal cuff during hysterectomy. *J Surg Educ.* 2015;72:212-9. <https://doi.org/10.1016/j.jsurg.2014.08.015>
14. Uccella S, Malzoni M, Cromi A. Laparoscopic vs transvaginal cuff closure after total laparoscopic hysterectomy: a randomized trial by the Italian Society of Gynecologic Endoscopy. *Am J Obstet Gynecol* 2018;218:500.e1-13. <https://doi.org/10.1016/j.ajog.2018.01.029>
15. Tunitsky-Bitton E, Propst K, Muffly T. Development and validation of a laparoscopic hysterectomy

- cuff closure simulation model for surgical training. *Am J Obstet Gynecol.* 2016;214:391-2. <https://doi.org/10.1016/j.ajog.2015.11.023>
16. Akdemir A, Zeybek B, Ozgurel B, Oztekin MK, Sendag F. Learning curve analysis of intracorporeal cuff suturing during robotic single-site total hysterectomy. *J Minim Invasive Gynecol.* 2015;22:384-389. <https://doi.org/10.1016/j.jmig.2014.06.006>
 17. Adelman MR, Bardsley TR, Sharp HT. Urinary tract injuries in laparoscopic hysterectomy: a systematic review. *J Minim Invasive Gynecol.* 2014;21(4):558-66. <https://doi.org/10.1016/j.jmig.2014.01.006>
 18. Ugurlu EN. Ureteric Injuries during Laparoscopic Gynecological Operations. *World Journal of Laparoscopic Surgery with DVD.* 2010;3(3):123-5. <https://doi.org/10.5005/jp-journals-10007-1096>
 19. King CR, Donnellan N, Guido R, Ecker A, Althouse AD, Mansuria S. Development and validation of a laparoscopic simulation model for suturing the vaginal cuff. *Obstet Gynecol.* 2015;126:27-35. <https://doi.org/10.1097/AOG.0000000000001053>
 20. O'Hanlan KA, Emenev PL, Peters A, Sten MS, McCutcheon SP, Struck DM, et al. Analysis of a standardized technique for laparoscopic cuff closure following 1924 total laparoscopic hysterectomies. *Minim Invasive Surg.* 2016;2016:1372685. <https://doi.org/10.1155/2016/1372685>
 21. Blikkendaal MD, Twijnstra AR, Pacquee SC, Rhemrev JPT, Smeets MJGH, de Kroon CD, et al. Vaginal cuff dehiscence in laparoscopic hysterectomy: influence of various suturing methods of the vaginal vault. *Gynecol Surg.* 2012;9:745. <https://doi.org/10.1007/s10397-012-0745-5>
 22. Herraiz RJL, Lluca AJA, Maazouzi Y, Piquer SD, Piquer SD, Calpe GE. The Use of Barbed Suture for Vaginal Cuff Closure in Total Laparoscopic Hysterectomy. *Obstet Gynecol Int J.* 2015;3(4):00088. <https://doi.org/10.15406/ogij.2015.03.00088>
 23. Nawfal AK, Eisenstein D, Theoharis E, Dahلمان M, Wegienka G. Vaginal cuff closure during robotic-assisted total laparoscopic hysterectomy: comparing vicryl to barbed sutures. *JSLs.* 2012;16:525-9. <https://doi.org/10.4293/108680812X13462882736772>
 24. Kim JH, Byun SW, Song JY, et al. Barbed versus conventional 2-layer continuous running sutures for laparoscopic vaginal cuff closure. *Medicine (Baltimore)* 2016;95:4981. <https://doi.org/10.1097/MD.0000000000004981>
 25. Mak F, Mourad J. Vertical Vaginal Cuff Closure: Posterior to Anterior Technique. *Journal of Minimally Invasive Gynecology.* 2023 Nov 1;30(11):S60. <https://doi.org/10.1016/j.jmig.2023.08.194>
 26. Förster CE, Calabretti I, Gubser L, Schötzau A, Fellmann-Fischer B, Heinzelmann-Schwarz V, et al. Comparison of different suture techniques for laparoscopic vaginal cuff closure. *Scientific Reports.* 2024 Feb 28;14(1):4860. <https://doi.org/10.1038/s41598-024-55586-5>
 27. Peters A, Ali R, Miles S, Foley CE, Buffie A, Ruppert K, et al. Two-layer compared with one-layer vaginal cuff closure at the time of total laparoscopic hysterectomy to reduce complications. *Obstetrics & Gynecology.* 2021 Jul 1;138(1):59-65. <https://doi.org/10.1097/AOG.0000000000004428>

CONFLICT OF INTEREST
 Authors declare no conflict of interest.
GRANT SUPPORT AND FINANCIAL DISCLOSURE
 None declared.

AUTHORS' CONTRIBUTION

The following authors have made substantial contributions to the manuscript as under:

Conception or Design:	AB, AG
Acquisition, Analysis or Interpretation of Data:	AB, AG, AF, NG
Manuscript Writing & Approval:	AB, AG, AF, NG

All the authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.



Copyright © 2024. Adil Bangash, et al. This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License, which permits unrestricted use, distribution & reproduction in any medium provided that original work is cited properly.